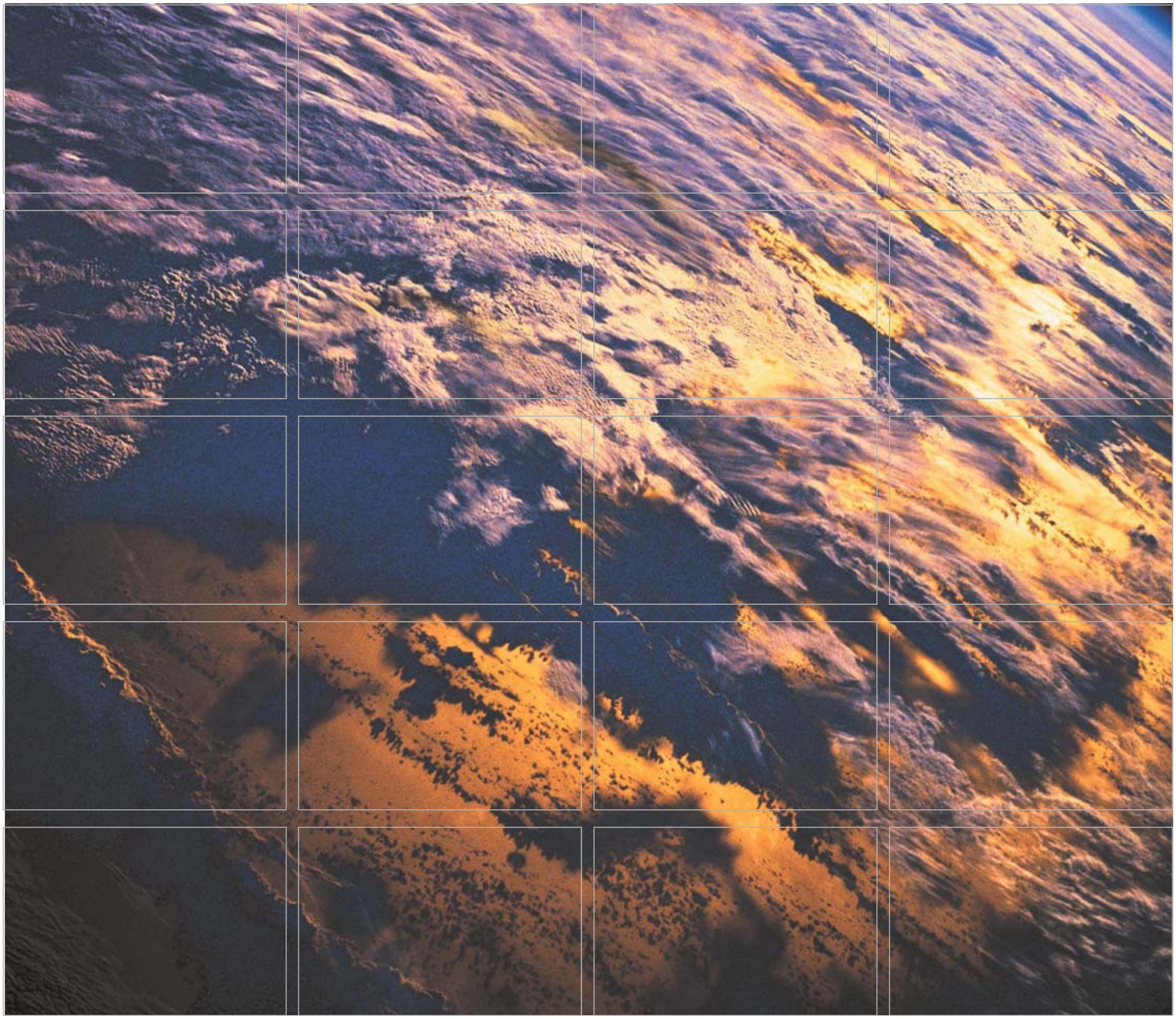


# Philadelphia Energy Solutions Refining and Marketing LLC

***Tier 3 Project***
***Philadelphia, Pennsylvania***

September 2015 – Original Application

April 2016 – Revision A

Environmental Resources Management
75 Valley Stream Parkway, Suite 200
Malvern, PA  19355
(484) 913-0300

www.erm.com

*The world's leading sustainability consultancy*

ERM

*TABLE OF CONTENTS*

*LIST OF TABLES*

***LIST OF ATTACHMENTS***

## *1.0 INTRODUCTION*

Philadelphia Energy Solutions Refining and Marketing, LLC (PES) owns and operates the Philadelphia Refining Complex (Complex) – including the Point Breeze Refinery, Girard Point Refinery, and the Schuylkill River Tank Farm. At the Philadelphia Refining Complex, PES is currently permitted to operate numerous desulfurization and hydrotreating processes at the Refinery under an existing permit (Title V Operating Permit No. V06-016). PES plans to reconfigure existing process units, re-route intermediate process streams, and expand hydrotreating process capacity to enable compliance with the Tier 3 gasoline standards. For the purpose of this application, the project is referred to as the "PES Tier 3 Project" or "Project."

### *1.1 TIER 3 GASOLINE*

The United State Environmental Protection Agency (USEPA) promulgated new standards for the sulfur content in gasoline in April 2014 referred to as the Tier 3 standards. Under the Tier 3 standards, gasoline will be required to meet an annual average standard of 10 parts per million by weight (ppmw) of sulfur by January 1, 2017. These standards are an extension of the Tier 2 standards, promulgated in February 2000, which required gasoline to meet an annual average standard of 30 ppmw.

USEPA estimates that the following nationwide reductions from onroad vehicles in **Table 1-1** below in nitrogen oxides ($NO_x$), volatile organic compounds (VOC), carbon monoxide (CO), direct particulate matter less than 2.5 microns ($PM_{2.5}$), and sulfur dioxide ($SO_2$) in 2018 and 2030.

***Table 1-1 USEPA Estimates of Nationwide Emissions Reductions from the Tier 3 Standards***

| Pollutant | 2018 | | 2030 | |
|---|---|---|---|---|
| | Tons | % of Onroad inventory | Tons | % of Onroad inventory |
| $NO_x$ | 264,369 | 10 | 328,509 | 25 |
| VOC | 47,504 | 3 | 167,591 | 16 |
| CO | 278,879 | 2 | 3,458,041 | 24 |
| $PM_{2.5}$ | 130 | 0.1 | 7,892 | 10 |
| $SO_2$ | 14,813 | 56 | 12,399 | 56 |

### 1.2 PES TIER 3 PROJECT

PES is proposing to make several operational and process changes to comply with the Tier 3 standards. The PES Tier 3 Project includes expansion of the sulfur removal capacity of the Unit 864 Naphtha Hydrotreating Unit and the Unit 870 Low Sulfur Gasoline (LSG) Unit at the Point Breeze Refinery as well as piping changes at the front end of the Unit 1332 Reformer Unit at the Girard Point Refinery. The changes will allow additional sulfur treatment, but not additional production, of finished gasoline, straight run naphtha, and other gasoline blending streams currently generated and processed at the refinery.

Proposed changes associated with the PES Tier 3 Project including the following:

- Expand the capacity of the Unit 864 Naphtha Hydrotreating Unit from 40 thousand barrels per day (MBPD) to a nominal 48 MBPD;
- Expand the capacity of the Unit 870 LSG Unit from 65 MBPD to a nominal 84 MBPD;
- Utilize the existing Unit 1332 hydrobon reactor to produce sweet naphtha for gasoline blending;
- Utilize vacuum deaerated water in the existing Unit 433 Alkylate Water Wash Tower[1] to remove water soluble sulfolane from alkylate products;
- Installation of low $NO_x$ burners (LNB) on the Unit 864 PH-1, Unit 864 PH-11, Unit 864 PH-12 refinery fuel gas fired heaters;
- Replacement of the Unit 864 PH-7 Heater with an idle heater from the former Sunoco Inc. (R&M) Eagle Point Refinery; and
- Installation of a new Unit 870 H-3 Heater.

The proposed installations are fully described in this permit application submitted to Air Management Services (AMS) by PES. PES has evaluated the emission changes associated with this Project and determined that the provisions of the Prevention of Significant Deterioration (PSD) do not apply;

[1] Note the use of vacuum deaerated water in the Unit 433 Alkylate Water Wash Tower process does not introduce air pollutant emissions to the atmosphere; therefore, it will not be discussed further in this plan approval application.

however, nonattainment New Source Review (NANSR) regulations are triggered by this Project.

### *1.3 PLAN APPROVAL APPLICATION CONTENT*

This plan approval describes the proposed new sources and regulatory analysis related to the PES Tier 3 Project. A more detailed description of the Project and the emissions associated with the Project are provided in Sections 2 and 3, respectively. A summary of the results of PSD and NANSR applicability analysis are presented in Section 4. The Best Available Technology Review is provided in Section 5. Reviews of applicable local, State and federal regulatory requirements are presented in Sections 6. Additional Project-related information is provided in the attachments as follows:

- AMS Plan Approval Application Forms (Attachment A);
- Site Location Map/Process Flow Diagrams (Attachment B);
- Back-up Emission Calculations (Attachment C);
- Contemporaneous Emissions Tables (Attachment D); and
- Best Available Technology $NO_x$ Control Cost Effectiveness Calculations (Attachment E).

## 2.0 PROJECT OVERVIEW

In this Project, PES is proposing to make operational and process changes to further desulfurize existing gasoline, straight run naphtha and other gasoline blending streams to meet the Tier 3 standards in the future. The expansions of the Unit 864 Naphtha Hydrotreating Unit and Unit 870 LSG Unit as well as the piping changes to the Unit 1332 hydrobon stripper and pre-fractionator are discussed in the sections below.

### 2.1 UNIT 864 NAPHTHA HYDROTREATING UNIT

In this Project, PES plans to expand the capacity of the Unit 864 Naphtha Hydrotreating Unit from 40 MBPD to a nominal 48 MBPD by re-traying towers; re-piping and re-routing streams within the unit; replacing or modifying charge, bottoms, and reflux pumps; and modifying and replacing fired heaters. An overall process flow diagram of the proposed changes to the Unit 864 Naphtha Hydrotreating Unit is included in **Attachment B**.

As a result of this Project, all fired heaters (Unit 864 PH-1, Unit 864 PH-11, and Unit 864 PH-12) associated with the Unit 864 Naphtha Hydrotreating Unit are expected to have increased utilization. Furthermore, PES will be replacing the existing Unit 864 PH-7 Heater (nominal firing duty of 45.0 million British Thermal units per hour [MMBtu/hr]) with an existing idle heater (LSG H-1) located at the former Sunoco Inc. (R&M) Eagle Point Refinery in New Jersey[2]. The replacement Unit 864 PH-13 Heater will include ultra-low $NO_x$ burners (ULNB) for $NO_x$ control and will have nominal firing duty of 70.0 MMBtu/hr.

As part of the Project, PES also plans to install LNB on the existing Unit 864 PH-1, Unit 864 PH-11, and Unit 864 PH-12 Heaters.

### 2.2 UNIT 870 LSG UNIT

The Unit 870 LSG Unit currently operates two parallel desulfurization trains with two reactors in series in each train to remove sulfur from fuels. In this Project, PES plans to expand the capacity from 65 MBPD to 84 MBPD by installing a new splitter tower between the reactors where splitter tower light ends will go to gasoline blending while the splitter tower bottoms will

[2] Sunoco Inc. (R&M) Eagle Point Facility (55781) Emission Unit U45.

be further desulfurized by the remainder of Unit 870 LSG Unit. The new splitter tower reboiler will require the installation of a new refinery fuel gas fired heater, Unit 870 H-3 Heater, with a nominal firing duty of 110.0 MMBtu/hr equipped with ULNB for $NO_x$ control. Other changes include adding pumps; re-routing piping; and installing new heat exchangers within the unit to allow for the expanded capacity. An overall process flow diagram of the proposed changes to the Unit 870 LSG Unit is included in **Attachment B**.

Also, as a result of this Project, both fired heaters (Unit 870 H-1 and Unit 870 H-2) associated with the Unit 870 LSG Unit are expected to have increased utilization, which will remain within each heater's existing firing rate limit. Both heaters currently have ULNB installed for $NO_x$ control. However, it was determined during the design phases for the Unit 870 LSG Unit that the existing ULNBs installed in the Unit 870 H-2 Heater will be replaced with a newer version of the same ULNB. Both the maximum firing capacity (MMBtu/hr) and $NO_x$ emission rate (lb/MMBtu) of the Unit 870 H-2 Heater will be unaffected by the change.

### *2.3 UNIT 1332 HYDROBON STRIPPER AND PRE-FRACTIONATOR*

The 1332 Reformer Unit includes the V-1 Pre-fractionator, V-3 Hydrobon Reactor system, V-6 Hydrobon Stripper system, and reformer/platformer. PES has determined that piping changes around the Unit 1332 V-6 Hydrobon Stripper system can be made to allow sweet naphtha to be routed to the gasoline blending pool. This allows the V-3 Hydrobon Reactor to provide sweet naphtha for gasoline blending as opposed to the current operation of blending untreated higher sulfur naphtha from Unit 137 Crude Unit directly into gasoline. To accomplish this, PES plans to re-route a portion of the V-6 Hydrobon Stripper bottoms to sweet naphtha storage tanks and re-route the V-1 Pre-fractionator overhead to the Unit 864 Naphtha Hydrotreating Unit for further processing. An overall process flow diagram of the proposed changes to the Unit 1332 V-6 Hydrobon Stripper system and V-1 Pre-fractionator is included in **Attachment B**.

As a result of this Project, PES plans to process more material through the Hydrobon system than in the recent past (approximately 41 MBPD); while not increasing the material processing on the reformer/platformer. However, the Hydrobon system is already capable of achieving this throughput[3] and no physical modifications to the overall processing capacity of the unit will be required. Additionally, the modifications proposed at the Unit 864 Naphtha Hydrotreating Unit and Unit 870 LSG Unit will not directly affect the planned material processing at the Unit 1332 V-6 Hydrobon Stripper system and V-1 Pre-Fractionator. For these reasons, the Unit 1332 V-6 Hydrobon Stripper system and V-1 Pre-Fractionator will only experience increased utilization without being debottlenecked. The Unit 1332 H-2 and H-3 Heaters are not considered "modified" and each source's potential to emit (PTE) remains unaffected. However, the emissions impacts associated with this change are incorporated into the NANSR and PSD applicability determinations. Furthermore, the type of material stored and the overall throughput of the sweet naphtha storage tanks will not be affected by this Project.

## 2.4 *ANCILLARY SOURCES AND UTILITIES*

The PES Tier 3 Project will expand the gasoline hydrotreating capacity of the Complex thus expanding the incremental utilization of ancillary utilities such as steam generating sources, cooling towers, and the Unit 867 Sulfur Recovery Unit (SRU) relative to their baseline period. The following approximate impacts from ancillary sources and utilities are expected as a result of the Project:

- 600 gallons per minute (gpm) of incremental cooling water will be required at the Unit 864 Naphtha Hydrotreating Unit, which will be processed by the existing Unit 864 Cooling Tower; and

- 0.45 tons per day (TPD) of incremental sulfur production as a result of additional sulfur being removed from finished gasoline, straight run naphtha, and other gasoline blending streams (See **Section 3.4.2** for incremental sulfur production calculation).

## 2.5 *NEW FUGITIVE EMISSIONS COMPONENTS*

Additional fugitive emissions components including valves, pressure relief devices, and flanges/connectors associated with the proposed changes will be installed as a part of this Project. A conservatively estimated list of

[3] PES has found numerous 30-day rolling periods from 2009 through to the present where the fired duties of the 1332 H-2 and H-3 Heaters have exceeded the expected annual average firing rates used for planning purposes for the Tier 3 Project.

fugitive components planned for this Project is summarized in **Table 2-1** below.

*Table 2-1 Fugitive Equipment Components*

| Equipment | Number of Components |
|---|---|
| Valves | 125 |
| Flanges | 250 |
| Connectors | - |
| Pump Seals | 13 |
| Other | - |

## *2.6 PROJECT SCHEDULE*

PES is planning to make the proposed changes to refinery units during scheduled turnarounds starting in the fourth quarter 2015. As noted above, construction must begin as soon as possible to ensure the Complex is producing Tier 3 gasoline by January 1, 2017.

## 3.0 DETAILED PROJECT EMISSIONS ANALYSIS

This section describes the calculations and assumptions made to estimate the emissions associated with PES Tier 3 Project. The emissions from the proposed Project including nitrogen oxides ($NO_x$), nitrogen dioxide ($NO_2$), sulfur dioxide ($SO_2$), carbon monoxide (CO), volatile organic compounds (VOC), particulate matter (PM), particulate matter less than 10 microns ($PM_{10}$), particulate matter less than 2.5 microns ($PM_{2.5}$), lead, and greenhouse gas (GHG) emissions (shown as carbon dioxide equivalents [$CO_2e$]) are detailed below. **Table 3-22** at the end of this section shows the total PES Tier 3 Project emissions. Detailed emissions calculations are presented in **Attachment C**.

PES has determined that certain emissions sources associated with the Unit 864 Naphtha Hydrotreating Unit and Unit 870 LSG Unit have been debottlenecked and "modified" due a physical change or a change in the method of operation of the source. In the case of this Project, due to the expansion of treating capacity of both units, the following fired heaters will have a change in the method of operation as defined in 25 PA Code §121.1:

- Unit 864 PH-1 Heater;
- Unit 864 PH-11 Heater;
- Unit 864 PH-12 Heater;
- Unit 870 H-1 Heater; and
- Unit 870 H-2 Heater.

As per 25 PA Code §127.203a(a)(4)(i) and 40 Code of Federal Regulations (CFR) §52.21(b)(48), BAE were estimated as the highest annual average "during a consecutive 24-month period selected by the owner or the operator within the 5-year period immediately prior to the date a complete plan approval application is received by the Department."

The annual average expected firing rates of each heater (future expected operation) were calculated based on process simulations of the proposed changes to the process units affected by the Project. This annual average firing rate can be predicted, but due to the complexity of the processes and the variability of hydrocarbon streams that can be processed by the units, the firing rate will vary. Based on the accuracy of the process simulations and to provide for contingency in the potential firing rate limit, PES has elected to calculate the net emissions increase for modified sources using the existing potential firing rate limits, which effectively defines each sources' PTE, found in Title V Operating Permit No. V06-016 and the RACT Plan Approval issued February 9, 2016. This methodology is allowed by 25 Pa Code §127.203a(5)(ii), which states "In lieu of using the method set out in subparagraph (i), the owner or operator of the major facility may elect to use the emissions unit's potential to emit, in TPY." Note that this methodology of using each modified heater's PTE represents a conservative methodology for estimating the net emissions impact from the Project.

Note that the Unit 864 PH-7 Heater will be replaced with a heater from the former Sunoco Inc. (R&M) Eagle Point Refinery, which will be considered a new emissions source for PSD and NANSR purposes. The new splitter tower reboiler at the Unit 870 LSG Unit will require the installation of the new Unit 870 H-3 Heater. The Unit 864 PH-1 Heater has demonstrated an inability to operate at its current potential firing rate of 80.0 MMBtu/hr; therefore, the potential firing rate will be reduced to 74.9 MMBtu/hr. Lastly, the Unit 1332 H-2 and Unit 1332 H-3 Heaters are only expected to experience an increase in utilization as a result of this Project and are not being physically modified or debottlenecked.

The annual average expected firing rates used to determine the emissions impact of each fired heater affected by the PES Tier 3 Project are shown in **Table 3-1** below.

***Table 3-1 Expected Firing Rates of Each Affected Heater***

| Fired Heater | Annual Average Expected Firing Rate (MMBtu/hr)[1] |
|---|---|
| Unit 864 PH-1[2] | 74.9 |
| Unit 864 PH-11 | 74.0 |
| Unit 864 PH-12 | 85.1 |
| Unit 864 PH-13[3] | 70.0 |
| Unit 870 H-1 | 97.0 |
| Unit 870 H-2 | 53.0 |
| Unit 870 H-3[4] | 110.0 |
| Unit 1332 H-2 | 43.8 |
| Unit 1332 H-3 | 28.1 |

1 The annual average expected firing rates for the Unit 864 PH-11, Unit 864 PH-12, Unit 870 H-1, and Unit 870 H-2 Heaters match the potential firing rates limits found in Title V Operating Permit No. V06-016 and the RACT Plan Approval issued February 9, 2016.

2 The Unit 864 PH-1 Heater has demonstrated an inability to operate at its current potential firing rate of 80.0 MMBtu/hr; therefore, the potential firing rate will be reduced to 74.9 MMBtu/hr.

3 The Unit 864 PH-13 Heater (the existing LSG H-1 Heater from the former Sunoco Inc. (R&M) Eagle Point Refinery) will replace the existing Unit 864 PH-7 Heater.

4 This will be a new heater installed to provide the necessary heat for the new splitter tower reboiler.

## 3.1 UNIT 864 NAPHTHA HYDROTREATING UNIT EMISSIONS

The reconfiguration of the Unit 864 Naphtha Hydrotreating Unit will increase emissions from the Unit 864 PH-1, Unit 864 PH-11, and Unit 864 PH-12 Heaters. The BAE are based on the actual firing from each of these heaters during the period of June 2012 through May 2014. The annual emission changes in this Project reflect the difference between past actual emissions (BAE) and the potential firing rate limits (PTE). The BAE in tons per year (TPY) for the Unit 864 PH-1, Unit 864 PH-11, and Unit 864 PH-12 Heaters are provided in **Table 3-2** below.

*Table 3-2 Baseline Actual Emissions for Unit 864 Naphtha Hydrotreating Unit Heaters*

| Pollutant | Baseline Actual Emissions (TPY) | | |
|---|---|---|---|
| | **Unit 864 PH-1** | **Unit 864 PH-11** | **Unit 864 PH-12** |
| $NO_x$ | 22.3 | 25.7 | 26.7 |
| $SO_2$ | 0.4 | 0.5 | 0.6 |
| CO | 10.9 | 14.5 | 18.3 |
| PM | 1.0 | 1.3 | 1.7 |
| $PM_{10}$ | 1.0 | 1.3 | 1.7 |
| $PM_{2.5}$ | 1.0 | 1.3 | 1.7 |
| VOC | 0.7 | 0.9 | 1.2 |
| Lead | 6.5E-05 | 8.6E-05 | 1.1E-04 |
| $CO_2e$ | 15,657 | 20,740 | 26,306 |

The baseline actual $NO_x$ emission rates for the Unit 864 PH-1, Unit 864 PH-11, and Unit 864 PH-12 Heaters are the emission rates limits found in Title V Operating Permit No. V06-016 and the RACT Plan Approval issued February 9, 2016. The Unit 864 PH-7 Heater is being replaced with an idle heater (LSG H-1) located at the Eagle Point Refinery; therefore, the emissions associated with this source will be based on the source's potential to emit (PTE). This replacement heater, Unit 864-PH-13, is equipped with ULNB that will achieve a $NO_x$ emission rate of 0.02 pounds per MMBtu (lb/MMBtu) as indicated by the Eagle Point Title V Operating Permit. Also as part of the Project, PES has elected to install LNB on the Unit 864 PH-1, Unit 864 PH-11, and Unit 864 PH-12 Heaters that will achieve a $NO_x$ emission rate of 0.06 lb/MMBtu.

This Project will result in an increase in firing of certain heaters; however, it is not expected to have an impact on the amount of sulfur in the refinery fuel gas, which is the only fuel for refinery heaters. Therefore, $SO_2$ emissions are calculated using heater-specific $SO_2$ emission factors based on average actual firing rates and average actual $SO_2$ emissions from 2013 and 2014. The actual $SO_2$ emissions from each heater were based on mass balance calculations of measured $H_2S$ content in the refinery fuel gas (RFG).

Consistent with historic practices, PES used USEPA AP-42 emission factors for VOC, PM, $PM_{10}$, $PM_{2.5}$, and CO that are adjusted for the higher heating value (HHV) of the RFG combusted at each heater. The baseline average HHV for the Unit 864 Hydrotreating Unit Heaters is 1,028 Btu/scf. The Unit 864 PH-13 Heater, originally installed at the LSG Unit at the former Eagle Point Refinery, has an identical design as the Unit 870 H-1 and Unit 870 H-2 Heaters. Therefore, the $PM_{2.5}$ emissions rate as demonstrated by stack testing at the Unit 870 LSG Unit Heaters was used for the Unit 864 PH-13 Heater. Similarly for the Unit 864 PH-13 Heater, the CO emission rate limit found in the Eagle Point Title V Operating Permit was used.

The $CO_2e$ emissions were calculated using emission factors from the Greenhouse Gas Mandatory Reporting Rule (GHGMRR) codified at 40 CFR Part 98. The emission factors and source information for each pollutant for each of the Unit 864 Hydrotreating Unit Heaters is provided in **Tables 3-3 and 3-4** below, respectively.

*Table 3-3 Emission Factors for Unit 864 Naphtha Hydrotreating Unit Heaters*

| Pollutant | Emissions Factors (lb/MMBtu) | | | |
|---|---|---|---|---|
| | Unit 864 PH-1 | Unit 864 PH-11 | Unit 864 PH-12 | Unit 864 PH-13 |
| $NO_x$ | 0.167 | 0.145 | 0.119 | 0.02 |
| $NO_x$ (after LNB install) | 0.06 | 0.06 | 0.06 | - - - |
| $SO_2$ | 0.003 | 0.003 | 0.003 | 0.003 |
| CO | 0.082 | 0.082 | 0.082 | 0.032 |
| PM | 0.0074 | 0.0074 | 0.0074 | 0.0074 |
| $PM_{10}$ | 0.0074 | 0.0074 | 0.0074 | 0.0074 |
| $PM_{2.5}$ | 0.0074 | 0.0074 | 0.0074 | 0.0023 |
| VOC | 0.0053 | 0.0053 | 0.0053 | 0.0053 |
| Lead | 4.9E-07 | 4.9E-07 | 4.9E-07 | 4.9E-07 |
| $CO_2e$ | 117.1 | 117.1 | 117.1 | 117.1 |

*Table 3-4 Source of Emissions Factors for Unit 864 Naphtha Hydrotreating Unit Heaters*

| Pollutant | Emissions Factors Source Information | | | |
|---|---|---|---|---|
| | **Unit 864 PH-1** | **Unit 864 PH-11** | **Unit 864 PH-12** | **Unit 864 PH-13** |
| $NO_x$ | Current Title V and RACT Limit | Current Title V and RACT Limit | Current Title V and RACT Limit | Permit Limit from Eagle Point Title V Operating Permit |
| $NO_x$ (after LNB install) | Vendor Guarantee | Vendor Guarantee | Vendor Guarantee | - - - |
| $SO_2$ | Mass Balance | Mass Balance | Mass Balance | Mass Balance |
| CO | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | Permit Limit from Eagle Point Title V Operating Permit |
| PM | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV |
| $PM_{10}$ | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV |
| $PM_{2.5}$ | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | Permit Limit from Eagle Point Title V Permit |
| VOC | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV |
| Lead | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV |
| $CO_2e$ | 40 CFR Part 98 | 40 CFR Part 98 | 40 CFR Part 98 | 40 CFR Part 98 |

The potential emissions estimated from the annual average expected firing rates and emission factors presented above from each of the Unit 864 Hydrotreating Unit Heaters are shown in **Table 3-5** below.

*Table 3-5 Potential to Emit for Unit 864 Naphtha Hydrotreating Unit Heaters*

| Pollutant | Potential to Emit (TPY) | | | |
|---|---|---|---|---|
| | **Unit 864 PH-1** | **Unit 864 PH-11** | **Unit 864 PH-12** | **Unit 864 PH-13** |
| $NO_x$ | 19.7 | 19.4 | 22.4 | 6.5 |
| $SO_2$ | 0.9 | 0.9 | 1.0 | 0.9 |
| CO | 26.8 | 26.5 | 30.4 | 9.7 |
| PM | 2.4 | 2.4 | 2.8 | 2.3 |
| $PM_{10}$ | 2.4 | 2.4 | 2.8 | 2.3 |
| $PM_{2.5}$ | 2.4 | 2.4 | 2.8 | 0.7 |
| VOC | 1.8 | 1.7 | 2.0 | 1.6 |
| Lead | 1.6E-04 | 1.6E-04 | 1.8E-04 | 1.5E-04 |
| $CO_2e$ | 38,415 | 37,953 | 43,646 | 35,902 |

The annual emissions increases (PTE minus BAE) for each of the Unit 864 Naphtha Hydrotreating Unit Heaters are shown below in **Table 3-6**.

*Table 3-6 Projected Unit 864 Naphtha Hydrotreating Unit Heater Emissions Increases*

| Pollutant | Unit 864 PH-1 Heater (TPY) | Unit 864 PH-11 Heater (TPY) | Unit 864 PH-12 Heater (TPY) | Unit 864 PH-13 Heater (TPY) | Total Unit 864 Emissions (TPY) |
|---|---|---|---|---|---|
| $NO_x$[1] | -2.6 | -6.2 | -4.4 | 6.5 | **-6.8** |
| $NO_2$ | - - - | - - - | - - - | 6.5 | **6.5** |
| $SO_2$ | 0.5 | 0.4 | 0.4 | 0.9 | **2.2** |
| CO | 15.9 | 12.0 | 12.1 | 9.7 | **49.7** |
| PM | 1.4 | 1.1 | 1.1 | 2.3 | **5.9** |
| $PM_{10}$ | 1.4 | 1.1 | 1.1 | 2.3 | **5.9** |
| $PM_{2.5}$ | 1.4 | 1.1 | 1.1 | 0.7 | **4.3** |
| VOC | 1.0 | 0.8 | 0.8 | 1.6 | **4.2** |
| Lead | 9.4E-05 | 7.1E-05 | 7.2E-05 | 1.5E-04 | **3.9E-04** |
| $CO_2e$ | 22,758 | 17,213 | 17,341 | 35,902 | **93,214** |

1 $NO_x$ emissions for the Unit 864 PH-1, Unit 864 PH-11, and Unit 864 PH-12 heaters are based on the sum of the Project emissions for this source (PTE minus BAE) under 25 PA §127.203(b)(1)(i). Under 25 PA Code §127.203a(a)(1)(ii), $NO_2$ emissions for these heaters are based on Step 1 emissions increases only, where these sources are not expected to have an increase in $NO_2$ emissions.

The emissions associated with the shutdown of the existing Unit 864 PH-7 Heater are the annual average emissions based actual emissions for the period of June 2012 through May 2014 and are shown in **Table 3-7** below.

*Table 3-7 Unit 864 PH-7 Heater Shutdown Emissions*

| Pollutant | Total Unit 864 PH-7 Heater Shutdown Emissions (TPY) |
|---|---|
| $NO_x$ | -10.2 |
| $SO_2$ | -0.3 |
| CO | -9.9 |
| PM | -0.9 |
| $PM_{10}$ | -0.9 |
| $PM_{2.5}$ | -0.9 |
| VOC | -0.7 |
| Lead | -5.9E-05 |
| $CO_2e$ | -13,511 |

## 3.2 UNIT 870 LSG UNIT EMISSIONS

The expansion of the Unit 870 LSG Unit will increase emissions from the Unit 870 H-1 Heater and the Unit 870 H-2 Heater. The BAE for the Unit 870 H-1 and Unit 870 H-2 Heaters are based on the actual firing from each of these heaters during the period of June 2012 through May 2014. The annual emission changes in this Project reflect the difference between past actual emissions (BAE) and the potential firing rate limits (PTE). The BAE for the Unit 870 H-1 and Unit 870 H-2 Heaters are provided in **Table 3-8** below.

*Table 3-8 Baseline Actual Emissions for Unit 870 LSG Unit Heaters*

| Pollutant | Baseline Actual Emissions (TPY) | |
|---|---|---|
| | Unit 870 H-1 | Unit 870 H-2 |
| $NO_x$ | 4.5 | 3.9 |
| $SO_2$ | 0.4 | 0.4 |
| CO | 0.2 | 0.0 |
| PM | 1.0 | 0.4 |
| $PM_{10}$ | 1.0 | 0.4 |
| $PM_{2.5}$ | 0.4 | 0.3 |
| VOC | 0.1 | 0.1 |
| Lead | 7.6E-05 | 6.7E-05 |
| $CO_2e$ | 18,336 | 16,240 |

$NO_x$, PM, $PM_{10}$, $PM_{2.5}$, VOC, and CO emission factors were developed for the Unit 870 H-1 and Unit 870 H-2 Heaters based on stack testing.

As part of the installation of the new splitter tower in the Unit 870 LSG Unit, the new Unit 870 H-3 Heater will be installed to provide the necessary heat for the splitter tower reboiler. This heater will be equipped with ULNB that will achieve a $NO_x$ emission rate of 0.03 lb/MMBtu. The vendor also provided guaranteed emission rates for CO and VOC emissions. PM and $PM_{10}$ emission factors for the Unit 870 H-3 Heater are based on USEPA AP-42 emission factors that are adjusted for the HHV of the RFG combusted in this heater. The baseline average HHV for the Unit 870 LSG Unit Heaters is 1,028 Btu/scf. The $PM_{2.5}$ emission factor is assumed to be the same as the Unit 870 H-1 and 870 H-2 Heater stack test factor because these heaters will fire a similar fuel.

Similar to the Unit 864 Naphtha Hydrotreating Unit heaters, $SO_2$ emissions are calculated using heater-specific $SO_2$ emission factors based on average actual firing rates and average actual $SO_2$ emissions from 2013 and 2014. The actual $SO_2$ emissions from each heater were based on mass balance calculations of measured $H_2S$ content in the refinery fuel gas (RFG).

The $CO_2e$ emissions were calculated using emission factors from the GHGMRR codified at 40 CFR Part 98. The emission factors and source information for each pollutant for each of the Unit 870 LSG Unit Heaters is provided in **Tables 3-9 and 3-10** below, respectively.

*Table 3-9 Emissions Factors for Unit 870 LSG Unit Heaters*

| Pollutant | Emissions Factors (lb/MMBtu) | | |
|---|---|---|---|
| | Unit 870 H-1 | Unit 870 H-2 | Unit 870 H-3 |
| $NO_x$ | 0.029 | 0.028 | 0.030 |
| $SO_2$ | 0.002 | 0.003 | 0.002 |
| CO | 0.001 | 0 | 0.030 |
| PM | 0.0063 | 0.0025 | 0.0074 |
| $PM_{10}$ | 0.0063 | 0.0025 | 0.0074 |
| $PM_{2.5}$ | 0.0023 | 0.0023 | 0.0023 |
| VOC | 0.0004 | 0.0009 | 0.0050 |
| Lead | 4.9E-07 | 4.9E-07 | 4.9E-07 |
| $CO_2e$ | 117.1 | 117.1 | 117.1 |

*Table 3-10 Source of Emission Factors for Unit 870 LSG Unit Heaters*

| Pollutant | Emissions Factors Source Information | | |
|---|---|---|---|
| | Unit 870 H-1 | Unit 870 H-2 | Unit 870 H-3 |
| $NO_x$ | Stack Test Jan/Feb 2006 | Stack Test Jan/Feb 2006 | Vendor Guarantee |
| $SO_2$ | Mass Balance | Mass Balance | Mass Balance |
| CO | Stack Test Jan/Feb 2006 | Stack Test Jan/Feb 2006 | Vendor Guarantee |
| PM | Stack Test Jan/Feb 2006 | Stack Test Jan/Feb 2006 | AP-42 Adjusted for HHV |
| $PM_{10}$ | Stack Test Jan/Feb 2006 | Stack Test Jan/Feb 2006 | AP-42 Adjusted for HHV |
| $PM_{2.5}$ | Stack Test Jan/Feb 2006 | Stack Test Jan/Feb 2006 | Assumed the same as Unit 870 H-1 and H-2 |
| VOC | Stack Test Jan/Feb 2006 | Stack Test Jan/Feb 2006 | Vendor Guarantee |
| Lead | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV |
| $CO_2e$ | 40 CFR Part 98 | 40 CFR Part 98 | 40 CFR Part 98 |

The potential emissions estimated from the annual average expected firing rates and emission factors presented above from each of the Unit 870 LSG Unit Heaters are shown in **Table 3-11** below.

*Table 3-11 Potential to Emit for Unit 870 LSG Unit Heaters*

| Pollutant | Potential to Emit (TPY) | | |
|---|---|---|---|
| | Unit 870 H-1 | Unit 870 H-2 | Unit 870 H-3 |
| $NO_x$ | 12.3 | 6.5 | 14.5 |
| $SO_2$ | 1.0 | 0.6 | 1.1 |
| CO | 0.6 | 0.0 | 14.5 |
| PM | 2.7 | 0.6 | 3.6 |
| $PM_{10}$ | 2.7 | 0.6 | 3.6 |
| $PM_{2.5}$ | 1.0 | 0.5 | 1.1 |
| VOC | 0.2 | 0.2 | 2.4 |
| Lead | 2.1E-04 | 1.1E-04 | 2.3E-04 |
| $CO_2e$ | 49,750 | 27,183 | 56,417 |

The annual emissions increases (PTE minus BAE) for each of the Unit 870 LSG Unit heaters are shown below in **Table 3-12**.

*Table 3-12 Projected Unit 870 LSG Unit Heater Emissions Increases*

| Pollutant | Unit 870 H-1 Heater (TPY) | Unit 870 H-2 Heater (TPY) | Unit 870 H-3 Heater (TPY) | Total Unit 870 Emissions (TPY) |
|---|---|---|---|---|
| $NO_x$ | 7.8 | 2.6 | 14.5 | **24.9** |
| $NO_2$ | 7.8 | 2.6 | 14.5 | **24.9** |
| $SO_2$ | 0.6 | 0.3 | 1.1 | **2.0** |
| CO | 0.4 | 0.0 | 14.5 | **14.8** |
| PM | 1.7 | 0.2 | 3.6 | **5.5** |
| $PM_{10}$ | 1.7 | 0.2 | 3.6 | **5.5** |
| $PM_{2.5}$ | 0.6 | 0.2 | 1.1 | **1.9** |
| VOC | 0.1 | 0.1 | 2.4 | **2.6** |
| Lead | 1.3E-04 | 4.5E-05 | 2.3E-04 | **4.1E-04** |
| $CO_2e$ | 31,413 | 10,943 | 56,417 | **98,773** |

## *3.3 UNIT 1332 HYDROBON STRIPPER AND PRE-FRACTIONATOR EMISSIONS*

The fugitive VOC emissions from piping connections planned for the Unit 1332 V-6 Hydrobon Stripper system and V-1 Pre-fractionator are included in **Section 3.5** below.

The BAE are based on the actual firing from the Unit 1332 H-2 and Unit 1332 H-3 Heaters during the period of June 2012 through May 2014. The annual emission changes in this Project reflect the difference between past actual emissions (BAE) and future projected actual emissions (PAE) based on the expected average hourly firing rate of these heaters as a result of this Project. That is, the emissions increases are based on the incremental demand on these non-modified heaters due to increased processing of streams through the Unit 1332 Hydrobon equipment. The BAE for the 1332 H-2 and Unit 1332 H-3 Heaters are provided in **Table 3-13** below.

*Table 3-13 Baseline Actual Emissions for Unit 1332 H-2 and H-3 Heaters*

| Pollutant | Baseline Actual Emissions (TPY) | |
|---|---|---|
| | Unit 1332 H-2 | Unit 1332 H-3 |
| $NO_x$ | 4.3 | 9.9 |
| $SO_2$ | 0.5 | 0.3 |
| CO | 1.4 | 8.3 |
| PM | 1.0 | 0.8 |
| $PM_{10}$ | 1.0 | 0.8 |
| $PM_{2.5}$ | 1.0 | 0.8 |
| VOC | 0.7 | 0.5 |
| Lead | 6.6E-05 | 5.0E-05 |
| $CO_2e$ | 16,360 | 12,371 |

$NO_x$ and CO emission factors were developed for the Unit 1332 H-2 Heater based on stack testing, while USEPA AP-42 emissions factors were used for $NO_x$ and CO emissions from the Unit 1332 H-3 Heater. Consistent with historic practices for both heaters, PES used USEPA AP-42 emission factors for VOC, PM, $PM_{10}$, and $PM_{2.5}$ that are adjusted for the higher heating value (HHV) of the RFG combusted at each heater. The baseline average HHV for the Unit 1332 H-2 and H-3 Heaters is 1,066 Btu/scf.

Similar to the Unit 864 Naphtha Hydrotreating Unit and Unit 870 LSG Unit Heaters, $SO_2$ emissions are calculated using heater-specific $SO_2$ emission factors based on average actual firing rates and average actual $SO_2$ emissions from 2013 and 2014. The actual $SO_2$ emissions from each heater were based on mass balance calculations of measured $H_2S$ content in the refinery fuel gas (RFG).

The $CO_2e$ emissions were calculated using emission factors from the GHGMRR codified at 40 CFR Part 98. The emission factors and source information for each pollutant for the Unit 1332 H-2 and H-3 Heaters is provided in **Tables 3-14 and 3-15** below, respectively.

*Table 3-14 Emissions Factors for Unit 1332 H-2 and H-3 Heaters*

| Pollutant | Emissions Factors (lb/MMBtu) | |
|---|---|---|
| | Unit 1332 H-2 | Unit 1332 H-3 |
| $NO_x$ | 0.031 | 0.094 |
| $SO_2$ | 0.004 | 0.003 |
| CO | 0.010 | 0.079 |
| PM | 0.0071 | 0.0071 |
| $PM_{10}$ | 0.0071 | 0.0071 |
| $PM_{2.5}$ | 0.0071 | 0.0071 |
| VOC | 0.0052 | 0.0052 |
| Lead | 4.7E-07 | 4.7E-07 |
| $CO_2e$ | 117.1 | 117.1 |

*Table 3-15 Source of Emission Factors for Unit 1332 H-2 and H-3 Heaters*

| Pollutant | Emissions Factors Source Information | |
|---|---|---|
| | Unit 1332 H-2 | Unit 1332 H-3 |
| $NO_x$ | Stack Test 5/1/07 | AP-42 Adjusted for HHV |
| $SO_2$ | Mass Balance | Mass Balance |
| CO | Stack Test 5/1/07 | AP-42 Adjusted for HHV |
| PM | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV |
| $PM_{10}$ | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV |
| $PM_{2.5}$ | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV |
| VOC | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV |
| Lead | AP-42 Adjusted for HHV | AP-42 Adjusted for HHV |
| $CO_2e$ | 40 CFR Part 98 | 40 CFR Part 98 |

The projected actual emissions estimated from the annual average expected firing rates and emission factors presented above from the Unit 1332 H-2 and H-3 Heaters are shown in **Table 3-16** below.

*Table 3-16 Projected Actual Emissions for Unit 1332 H-2 and H-3 Heaters*

| Pollutant | Projected Actual Emissions (TPY) | |
|---|---|---|
| | Unit 1332 H-2 | Unit 1332 H-3 |
| $NO_x$ | 5.9 | 11.5 |
| $SO_2$ | 0.7 | 0.4 |
| CO | 1.9 | 9.7 |
| PM | 1.4 | 0.9 |
| $PM_{10}$ | 1.4 | 0.9 |
| $PM_{2.5}$ | 1.4 | 0.9 |
| VOC | 1.0 | 0.6 |
| Lead | 9.0E-05 | 5.8E-05 |
| $CO_2e$ | 22,439 | 14,389 |

The annual emissions increases (PAE minus BAE) for the Unit 1332 H-2 and H-3 Heaters are shown below in **Table 3-17**.

*Table 3-17 Projected Unit 1332 H-2 and H-3 Heaters Emissions Increases*

| Pollutant | Unit 1332 H-2 Heater (TPY) | Unit 1332 H-3 Heater (TPY) | Total Unit 1332 Emissions (TPY) |
|---|---|---|---|
| $NO_x$ | 1.6 | 1.6 | **3.2** |
| $NO_2$ | 1.6 | 1.6 | **3.2** |
| $SO_2$ | 0.2 | 0.1 | **0.2** |
| CO | 0.5 | 1.4 | **1.9** |
| PM | 0.4 | 0.1 | **0.5** |
| $PM_{10}$ | 0.4 | 0.1 | **0.5** |
| $PM_{2.5}$ | 0.4 | 0.1 | **0.5** |
| VOC | 0.3 | 0.1 | **0.4** |
| Lead | 2.4E-05 | 8.1E-06 | **3.2E-05** |
| $CO_2e$ | 6,079 | 2,018 | **8,097** |

## *3.4 ANCILLARY SOURCES AND UTILITIES EMISSIONS*

The PES Tier 3 Project will result in incremental demand on ancillary utilities such as cooling towers and the Unit 867 Sulfur Recovery Unit (SRU) relative to their baseline period. The sections below describe the emissions and calculations for each source.

### 3.4.1 *Incremental Cooling Water Emissions*

The incremental 600 gpm of incremental cooling water will be processed by the existing Unit 864 Cooling Tower. The emissions calculations assume an incremental recirculation rate of 600 gpm, an expected maximum dissolved solids concentration of 600 ppmw, and drift eliminator performance of 0.005%. USEPA's AP-42 Chapter 5 emission factors are used to provide a conservative estimate for potential VOC emissions. Emissions for PM, $PM_{10}$, and $PM_{2.5}$ are estimated based on the Reisman/Frisbie methodology[4]. The annual emissions for incremental cooling water are shown in **Table 3-18** below.

*Table 3-18 Projected Incremental Cooling Water Emissions*

| Pollutant | Incremental Cooling Water Emissions (TPY) |
|---|---|
| PM | 0.2 |
| $PM_{10}$ | 0.1 |
| $PM_{2.5}$ | 0.001 |
| VOC | 0.1 |

### 3.4.2 *Incremental Sulfur Production Emissions*

Based on an engineering analysis of the total sulfur reduction expected in the gasoline blending pool as a result of this Project shown in **Table 3-19** below, an incremental 0.45 TPD of sulfur production will be expected at the Unit 867 SRU.

[4] Reisman, J. and Frisbie, G., *Calculating Realistic PM10 Emissions From Cooling Towers.*

*Table 3-19 Projected Unit 867 SRU Incremental Sulfur Production*

| Parameter | Value | Units |
|---|---|---|
| Total Gasoline Pool Volume | 165,000 | BPD |
| Gasoline specific gravity | 0.71 | - - - |
| Gasoline density | 5.9 | lb/gal |
| Current Sulfur in Gasoline | 30 | ppmw |
| Expected Tier 3 Sulfur in Gasoline | 8.2 | ppmw |
| Total Gasoline Pool Volume | 41,035,302 | lb/day |
| Current Sulfur in Gasoline | 1231.1 | lb/day |
| Tier 3 Sulfur in Gasoline | 336.5 | lb/day |
| Sulfur removed | 894.6 | lb/day |
| **Additional sulfur load** | **0.45** | **ton/day** |

Emissions for $NO_x$, $SO_2$, and CO were developing by scaling actual Unit 867 SRU emissions and sulfur production for 2013 with the expected incremental sulfur production as a result of this Project. The annual emissions for incremental sulfur production are shown in **Table 3-20** below.

*Table 3-20 Projected Incremental Sulfur Production Emissions*

| Pollutant | Incremental Sulfur Production Emissions (TPY) |
|---|---|
| $NO_x$ | 0.1 |
| $NO_2$ | 0.1 |
| $SO_2$ | 0.2 |
| CO | 3.3 |

## *3.5 FUGITIVE EMISSIONS – PIPING COMPONENTS*

This proposed Project will result in an increase in VOC emissions from equipment leaks due to the installation of equipment such as flanges and valves required as part of the piping installations. PES has conservatively estimated a component count, including valves, flanges, connectors and pumps based on preliminary engineering design. Consistent with current PES practices, the emission increases from equipment leaks were calculated based on USEPA emission factors for the petroleum industry. Fugitive VOC emissions in tons per year from leaking equipment for the proposed Project are presented in **Table 3-21** below.

*Table 3-21 Projected Fugitive Component Emissions*

| Affected Units | New Fugitive Components | Number of Components | VOC Emissions (TPY)[1] |
|---|---|---|---|
| Unit 864, Unit 870, and Unit 1332 | Valves | 125 | 0.009 |
| | Flanges | 250 | 0.001 |
| | Pumps | 13 | 0.003 |
| **Total Emissions** | | | **0.013** |

1 Consistent with current PES practice, potential fugitive emissions are estimated based on the USEPA "Protocol for Equipment Leak Emission Estimates", EPA-453/R-95-017, Table 2-12.

## *3.6 TOTAL PROJECT EMISSIONS*

The total emissions from the PES Tier 3 Project are summarized in **Table 3-22** below.

## *Table 3-22 Total PES Tier 3 Project Emissions*

| Source | Pollutant (TPY) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $NO_x$ | $NO_2$ | $SO_2$ | CO | VOC | PM | $PM_{10}$ | $PM_{2.5}$ | $H_2SO_4$ | Lead | $CO_2e$ |
| Unit 864 PH-1 Heater | -2.6 | - - - | 0.5 | 15.9 | 1.0 | 1.4 | 1.4 | 1.4 | - - - | 9.4E-05 | 22,758 |
| Unit 864 PH-7 Heater[1] | -10.2 | - - - | - - - | - - - | -0.7 | - - - | - - - | - - - | - - - | - - - | - - - |
| Unit 864 PH-11 Heater | -6.2 | - - - | 0.4 | 12.0 | 0.8 | 1.1 | 1.1 | 1.1 | - - - | 7.1E-05 | 17,213 |
| Unit 864 PH-12 Heater | -4.4 | - - - | 0.4 | 12.1 | 0.8 | 1.1 | 1.1 | 1.1 | - - - | 7.2E-05 | 17,341 |
| Unit 864 PH-13 Heater | 6.5 | 6.5 | 0.9 | 9.7 | 1.6 | 2.3 | 2.3 | 0.7 | - - - | 1.5E-04 | 35,902 |
| Unit 870 H-1 Heater | 7.8 | 7.8 | 0.6 | 0.4 | 0.1 | 1.7 | 1.7 | 0.6 | - - - | 1.3E-04 | 31,413 |
| Unit 870 H-2 Heater | 2.6 | 2.6 | 0.3 | 0.0 | 0.1 | 0.2 | 0.2 | 0.2 | - - - | 4.5E-05 | 10,943 |
| Unit 870 H-3 Heater | 14.5 | 14.5 | 1.1 | 14.5 | 2.4 | 3.6 | 3.6 | 1.1 | - - - | 2.3E-04 | 56,417 |
| Unit 1332 H-2 Heater | 1.6 | 1.6 | 0.2 | 0.5 | 0.3 | 0.4 | 0.4 | 0.4 | - - - | 2.4E-05 | 6,079 |
| Unit 1332 H-3 Heater | 1.6 | 1.6 | 0.1 | 1.4 | 0.1 | 0.1 | 0.1 | 0.1 | - - - | 8.1E-06 | 2,018 |
| Incremental Cooling Water | - - - | - - - | - - - | - - - | 0.1 | 0.2 | 0.1 | 0.001 | - - - | - - - | - - - |
| Incremental Sulfur Production | 0.1 | 0.1 | 0.2 | 3.3 | - - - | - - - | - - - | - - - | - - - | - - - | - - - |
| Fugitive Components | - - - | - - - | - - - | - - - | 0.01 | - - - | - - - | - - - | - - - | - - - | - - - |
| Total Project Emissions | **11.2** | **34.6** | **4.7** | **69.7** | **6.7** | **12.0** | **12.0** | **6.7** | **0** | **8.3E-04** | **200,084** |

1 Consistent with 25 PA Code §127.203(b)(1)(i), the proposed increases or decreases in emissions from the project are aggregated. Therefore, the Unit 864 PH-7 Heater shutdown emissions for $NO_x$ and VOC are included in the Project emissions total.

## *4.0 NEW SOURCE REVIEW APPLICABILITY*

PES must comply with all federal and State requirements applicable to this proposed Project. The existing facility is a major stationary source for all criteria pollutants; therefore, the new sources in this Project must undergo a new source review analysis.

The PES Refining Complex is located in an area treated as severe nonattainment for ozone. It is designated as attainment for other pollutants. Because of the above designations, PES must evaluate the Project-related activities for the applicability of the NANSR program for VOC and $NO_x$ as ozone precursors, and the applicability of the PSD program for $NO_2$, $SO_2$, CO, PM, $PM_{10}$, $PM_{2.5}$, $H_2SO_4$, and lead. Under the NANSR program, the Project is considered a major modification for ozone if the VOC or $NO_x$ emissions exceed 25 TPY by itself or by aggregating with increases and decreases over the contemporaneous time period. Under PSD, a major modification occurs when $NO_2$ or $SO_2$ emissions exceed 40 TPY, CO emissions exceed 100 TPY, PM emissions exceed 25 TPY, $PM_{10}$ emissions exceed 15 TPY, $PM_{2.5}$ emissions exceed 10 TPY, $H_2SO_4$ emissions exceed 7 TPY, or lead emissions exceed 0.6 TPY.

### *4.1 GREENHOUSE GAS TAILORING RULE*

On 13 May 2010, EPA issued the final greenhouse gas (GHG) permitting rule officially known as the *Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule* establishing GHGs as a PSD pollutant and setting major source emission thresholds for GHGs on a $CO_2$ equivalent ($CO_2e$) basis. If any new construction or modification of an existing facility results in a net emissions increase above established major source thresholds for GHGs on a $CO_2e$ basis, GHG is considered a regulated pollutant for that project[5]. Under the rule, GHG pollutants are considered to include carbon dioxide ($CO_2$), methane ($CH_4$), nitrous oxide ($N_2O$), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride ($SF_6$).

---

[5] On June 23, 2014 in Utility Air Regulatory Group v. EPA, the Supreme Court overturned part of EPA's trigger for when new or modified sources must seek permits for their GHG emissions, holding that the agency can only impose GHG PSD or Title V permitting when a facility's conventional emissions would otherwise trigger PSD or Title V. When PSD is triggered for conventional pollutants, GHG BACT will still be required if GHG emissions are above yet to be determined de minimis levels (75,000 ton/yr and 100,000 ton/yr threshold must be revisited).

Phase I of the rule was effective on 2 January 2011 and affects sources that are newly constructed or modified and are a "major source" under PSD for any pollutant other than GHGs. Upon triggering PSD for a non-GHG pollutant, the source must then determine PSD applicability for GHGs under the "Tailoring Rule" provisions. Under Phase I, newly constructed or modified facilities having a net increase of more than 75,000 TPY of $CO_2e$, would trigger PSD for GHGs.

As noted, the Supreme Court ruling indicates that a project's GHG potential emissions alone cannot trigger PSD permitting requirements. In the court's opinion, GHG BACT would only be required if PSD is triggered for a conventional pollutant first. Therefore, Phase II of the "Tailoring Rule" is no longer in effect.

## *4.2 PREVENTION OF SIGNIFICANT DETERIORATION ANALYSIS*

The Prevention of Significant Deterioration regulations (40 CFR 52.21) are federal regulations that apply to new major sources or "major modifications" of existing "major stationary sources" located in attainment or unclassifiable areas for a given pollutant. The PSD regulations are enforced by AMS in accordance with 25 PA Code §127.81. The Philadelphia Refining Complex is a major stationary source, and a modification to the source that would result in a "significant emission increase" and a "significant net emissions increase" would trigger PSD applicability.

The PSD regulations define a major modification in 40 CFR 52.21(b)(3)(i) as any physical change in or change in the method of operation of a major stationary source that would result in a significant emission increase and a significant net emission increase of any pollutant subject to regulation under the Act. The regulation defines threshold levels of annual emission rates that constitute "significant increases" for a variety of pollutants. The PSD emissions analysis is performed as per applicable regulation in 25 PA Code §127.81 and 40 CFR §52.21.

In Step 1 of the analysis, the emissions increases from new sources are calculated. The emissions calculation methodology was described in the earlier sections. As indicated in **Table 4-1** below, $CO_2e$ emissions for the proposed Project exceed the PSD threshold; however, because a conventional pollutant is not triggered, the $CO_2e$ emissions are not subject to regulation under PSD.

*Table 4-1 PSD Emissions Analysis (Step 1)*

| Emissions | Pollutant (TPY) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **$NO_2$** | **$SO_2$** | **CO** | **PM** | **$PM_{10}$** | **$PM_{2.5}$** | **$H_2SO_4$** | **Lead** | **$CO_2e$** |
| PES Tier 3 Project | 34.6 | 4.7 | 69.7 | 12.0 | 12.0 | 6.7 | 0 | 8.3E-04 | 200,084 |
| PSD Significant Level | 40 | 40 | 100 | 25 | 15 | 10 | 7 | 0.6 | 75,000 |
| PSD Triggered (Before Netting Analysis) | No | No | No | No | No | No | No | No | No |

## 4.3 NONATTAINMENT NEW SOURCE REVIEW ANALYSIS - OZONE

Facilities located in nonattainment areas that plan construction or modification of a source must evaluate the applicability of nonattainment NSR. The requirements are defined in 25 PA Code §127.201 through §127.217. Sources located in a nonattainment area, ozone transport region, or attainment or unclassifiable area impacting a nonattainment area are subject to permit requirements defined in 25 PA Code §127.203. In Pennsylvania, facilities located in the five county area including Philadelphia County are subject to the special permit requirements codified at §127.203. Under the special permit requirements, proposed new sources are subject to the NANSR requirements if the cumulative emissions calculated, using either one of the two scenarios below, equals or exceeds 25 tons per year of $NO_x$ or VOC:

- Increases or decreases in emissions from the project are aggregated with other net emissions increases over the consecutive 5-calendar year period including the year in which the project is constructed; or

- Increases or decreases in emissions from the project are aggregated with other net emission increases or decreases over the previous 10-year period. In this case, the facility is subject only to the emissions offset requirements codified at §127.205.

If the resulting net change exceeds the applicable thresholds, those emissions must be offset by a ratio of 1.3 to 1. If the offsets come from internal emission reductions, then Lowest Achievable Emission Rate (LAER) requirement does not apply (25 PA Code §127.203(b)(3)).

**Table 4-2** below presents a summary of Project emissions for $NO_x$ and VOC aggregated with other net emissions increases over the consecutive 5-calendar year period including the year in which the Project construction is planned (calendar years 2011 through 2015). Contemporaneous Emissions Tables are provided in **Attachment D**.

*Table 4-2 NANSR Netting Analysis for $NO_x$ and VOC Emissions (5 calendar year)*

| Emissions | 5 calendar year $NO_x$ (TPY) | 5 calendar year VOC (TPY) |
|---|---|---|
| PES Tier 3 Project | 11.2 | 6.7 |
| Contemporaneous Increases | 12.8 | 8.6 |
| **Net Emissions Increase** | **24.1** | **15.3** |
| NA-NSR Significance Level | 25 | 25 |
| **NA-NSR Review Required** | **No** | **No** |

As shown in **Table 4-2** above, the 5 calendar year net emissions increases of $NO_x$ and VOC from the proposed Project are below the NANSR threshold of 25 tons per year. Therefore, the proposed Project is not subject to the LAER requirements of 25 PA Code §127.205.

**Table 4-3** below presents a summary of Project emissions for $NO_x$ and VOC aggregated with other net emission increases or decreases over the previous 10 year period.

*Table 4-3 NANSR Netting Analysis for $NO_x$ and VOC Emissions (10 year)*

| Emissions | 10 year $NO_x$ (TPY) | 10 year VOC (TPY) |
|---|---|---|
| PES Tier 3 Project | 11.2 | 6.7 |
| Contemporaneous Increases/Decreases | 23.4 | 23.8 |
| **Net Emissions Increase** | **34.6** | **30.5** |
| NANSR Significance Level | 25 | 25 |
| **NANSR Review Required** | **Yes** | **Yes** |

As shown in **Table 4-3** above, the 10 year net emissions increases of $NO_x$ and VOC from the proposed Project are above the NANSR applicability thresholds of 25 tons per year. Therefore, the proposed Project is subject to the offsetting requirements of 25 PA Code §127.205(3). PES plans to surrender 45.0 tons of $NO_x$ offsets (34.6 tons of $NO_x$ emissions at a 1.3:1 ratio) and 39.6 tons of VOC offsets (30.5 tons of VOC emissions at a 1.3:1 ratio). PES is in active discussion with AMS regarding the accounting of emission reductions from the former Marcus Hook Refinery that were established while the facility was considered part of the Philadelphia Refining Complex. While PES believes the reductions should be considered contemporaneous reductions, for simplicity for the proposed Project, PES plans to use a portion of the remaining $NO_x$ emission reduction credits (ERCs) generated from the shutdown of certain emissions sources at Marcus Hook to offset the 10 year net emissions increases of $NO_x$.

## 5.0 BAT DETERMINATION

In accordance with 25 PA Code §127.12, an applicant for Plan Approval must demonstrate that the emissions from a new source will be the minimum attainable through use of the Best Available Technology (BAT). BAT is defined as equipment, devices, methods or techniques as determined by the Department that will prevent, reduce or control emissions of air contaminants to the maximum degree possible and that are available or can be made available to the facility. 25 PA Code §121.1 (Definitions) defines a new source as a source that was constructed and commenced operation on or after July 1, 1972, or a source that was modified so that the fixed capital cost of new components exceeds 50% of the fixed capital cost that would be required to construct a comparable entirely new source.

The affected heaters in this proposed Project and their corresponding construction dates at the Complex are shown in **Table 5-1** below.

*Table 5-1 Affected Heater Construction Dates*

| Heater | Construction Date |
|---|---|
| Unit 864 PH-1 Heater | 1971 |
| Unit 864 PH-11 Heater | 1971 |
| Unit 864 PH-12 Heater | 1971 |
| Unit 864 PH-13 Heater | To be installed |
| Unit 870 H-1 Heater | 2004 |
| Unit 870 H-2 Heater | 2004 |
| Unit 870 H-3 Heater | To be installed |
| Unit 1332 H-2 Heater | 2005 |
| Unit 1332 H-3 Heater | 1958 |

The Unit 1332 H-3 Heater is excluded from this analysis because it was installed prior to July 1, 1972 and has not been modified since that date in any way that would result in the emission of an air contaminant not previously emitted. The Unit 870 H-1 Heater, Unit 870 H-2 Heater, and Unit 1332 H-2 Heater, all of which have ULNB installed, are excluded from this analysis because these sources were required to meet BAT at the time of installation and have not been modified since that date in any way that would result in the emission of an air contaminant not previously emitted.

While the Unit 864 PH-1, Unit 864 PH-11, and Unit 864 PH-12 heaters are planned to have LNB installed, the cost of this change will not be in excess of the 50% fixed capital cost described above for the Project to be considered a "new source" per 25 PA Code §121.1. The proposed replacement of the Unit 864 PH-7 Heater with an existing heater from the former Sunoco Inc. (R&M) Eagle Point Refinery and the proposed installation of the Unit 870 H-3 Heater are the only sources associated with the PES Tier 3 Project that are a "new source" per 25 PA Code §121.1.

PES has conducted a BAT analysis for the proposed Unit 864 PH-13 and Unit 870 H-3 Heaters. In this analysis PES reviewed information from various databases to determine recent requirements and emission limits for the new source associated with this Project, including:

- EPA's New Source Review website;
- U.S. EPA's RACT/BACT/LAER Clearinghouse (RBLC) Database;
- Various state air quality regulations and websites;
- Recent EPA consent decrees within the refining industry; and
- State and federal guidance documents.

Note that BAT is a pollutant-specific determination. Based on a review of established emission control technologies and emission limits in permits, the following sections document the results of the source and pollutant specific BAT determinations.

## *5.1 $NO_X$ CONTROLS*

The Unit 864 PH-13 and Unit 870 H-3 Heaters will be equipped with ULNB that will achieve a $NO_x$ emission rate of 0.02 lb/MMBtu and 0.03 lb/MMBtu, respectively. PES reviewed available and applicable $NO_x$ controls that have been installed on process heaters at refineries or similar operations. The only additional $NO_x$ control available beyond the controls planned is Selective Catalytic Reduction (SCR). The stack temperature of both the Unit 864 PH-13 and Unit 870 H-3 Heaters will be approximately 425 degrees Fahrenheit (°F) due to use of heat recovery in the stack that is integral to the process. According to the USEPA *Air Pollution Control Technology Fact Sheet* for SCR (EPA-452/F-03-032), the optimum operating temperature range for SCR is 480°F to 800°F. Therefore, the use of SCR on both the Unit 864 PH-13 and Unit 870 H-3 Heaters is not feasible.

Nonetheless, PES estimated the cost effectiveness for SCR for $NO_x$ control in addition to the currently installed ULNB on the Unit 864 PH-13 and Unit 870 H-3 Heaters in the BAT $NO_x$ cost effectiveness analysis presented in **Attachment E**. Cost effectiveness was calculated for SCR using the methodology in the regulations and in the "OAQPS Control Cost Manual" (EPA/452/B-02-001). Total annual costs are the sum of operating and maintenance (O&M) costs and capital recovery costs. The capital recovery costs assume the equipment will be amortized over a 20-year time frame at 20 percent interest, the rate PES uses for evaluating capital projects. Total capital required to implement SCR control and operating and maintenance costs were estimated using USEPA's *Alternative Control Techniques Document - $NO_x$ Emissions from Process Heaters (Revised)* – EPA-453/R-93-034. The cost effectiveness of the additional SCR control on the Unit 864 PH-13 Heater is approximately $137,000 per ton of $NO_x$ emissions reductions, while the cost effectiveness of the additional SCR control on the Unit 870 H-3 Heater is approximately $81,000 per ton of $NO_x$ emissions reductions.

Accordingly, ULNB are considered BAT for the Unit 864 PH-13 and Unit 870 H-3 Heaters.

## *5.2 CO CONTROLS*

The available emission controls for reducing CO emissions from process heaters include:

- Good combustion practices; and

- Oxidation catalysts.

Based on a review of the RBLC database and other permits issued for refineries, no documented cases of oxidation catalysts being implemented on similarly sized process heaters were identified. Therefore, installation of oxidation catalyst for heaters of this size has not been demonstrated and is not available. The lack of application in refineries is largely due to operational limitations of the oxidation catalysts. The installation of oxidation catalyst in flue gas containing more than trace levels of $SO_2$ will result in poisoning and deactivation of the catalyst by sulfur-containing compounds, as well as increasing the conversion of $SO_2$ to $SO_3$. This would increase condensable particulate matter emissions, which would foul the catalyst, in turn, prohibiting oxidation as well as increasing flue gas system corrosion rates.

Good combustion practice is the predominantly used control option for reducing CO emissions from process heaters. The use of combustion tuning and implementation of periodic maintenance on the process heaters ensure that the CO emissions are limited.

Accordingly, good combustion practices are BAT for limiting CO emissions from the Unit 864 PH-13 and Unit 870 H-3 Heaters.

## *5.3 $PM/PM_{10}/PM_{2.5}$ CONTROLS*

The available emission control options for reducing $PM/PM_{10}/PM_{2.5}$ emissions from process heaters include:

- Good combustion practices;
- Electrostatic precipitators;
- Baghouse or fabric filters; and
- Use of gaseous fuels.

Refinery fuel gas will be used as the only fuel for the Unit 864 PH-13 and Unit 870 H-3 Heaters. Based on our review of the RBLC database and permits issued at refineries, ESPs or baghouses are not installed on similarly sized heaters fired on refinery fuel gas. Though these control options are potentially technically feasible for combustion sources such as process heaters, they are not commercially demonstrated on similarly sized process heaters. Therefore, these control options are not further considered in this evaluation. The refinery fuel gas fired in the heaters is comprised of a significant amount of natural gas and therefore, is similar in heating value and characteristics to natural gas.

BAT for the Unit 864 PH-13 and Unit 870 H-3 Heaters for limiting $PM/PM_{10}/PM_{2.5}$ emissions is good combustion practices and firing of refinery fuel gas.

## *5.4 $SO_2$ CONTROLS*

The available emission control options for minimizing $SO_2$ emissions from process heaters includes:

- Wet flue gas desulfurization (FGD) scrubber;

- Dry FGD scrubber; and
- Use of gaseous fuels.

Based on a review of EPA's RBLC database, and permits issued for refineries, wet FGD and dry FGD systems have not been installed on natural gas or refinery fuel gas fired heaters at any refinery in the country. Though these control options are potentially technically feasible for combustion sources such as process heaters, they are not commercially demonstrated on similarly sized process heaters. Therefore, these control options are not considered further in this evaluation.

Refinery fuel gas consists of a combination of refinery process by-product gas and natural gas. The refinery by-product gas is desulfurized prior to supplementing with natural gas through a mix drum in order to ensure New Source Performance Standards Subpart J limits are met prior to combustion. Refinery fuel gas is used at every refinery in the country as part of balancing available energy from process operations and by-products.

The use of low sulfur refinery fuel gas is BAT for the Unit 864 PH-13 and Unit 870 H-3 Heaters for $SO_2$.

## *5.5 VOC CONTROLS*

The available emission control options for minimizing VOC emissions from the process heaters includes:

- Oxidation catalysts; and
- Good combustion practices; and
- Use of gaseous fuels.

Based on our review of the RBLC databases, oxidation catalysts have not been demonstrated for VOC control on process heaters at refineries. The predominant control option to reduce VOC emissions from process heaters is the use of good combustion practices.

The Unit 864 PH-13 and Unit 870 H-3 Heaters will only fire refinery fuel gas which is lower in VOC content than liquid fuels and some other gaseous fuels. The Refinery removes many VOCs from the by-product gases before they are sent to the refinery fuel gas system and thus refinery fuel gas consists of mostly non-VOC compounds such as methane, ethane, and hydrogen.

The use of good combustion practices and firing of refinery fuel gas is BAT for the Unit 864 PH-13 and Unit 870 H-3 Heaters for VOC.

## 6.0 APPLICABLE STANDARDS ANALYSIS

The following sections review the applicability of local, state, and federal regulations including National Emission Standards for Hazardous Air Pollutants (NESHAPS) and New Source Performance Standards (NSPS) to the PES Tier 3 Project.

## 6.1 AIR MANAGEMENT SERVICES REGULATIONS

AMS Regulations incorporate Pennsylvania air contaminant emissions limits and control efficiencies (Regulation I, Section X) and include by reference, the federal regulations (AMS Regulation 1, Section XI). AMS also regulates $SO_2$ emissions (Regulation III, Section II), fuel sulfur content (Regulation III, Section III), pump and compressor emissions (Regulation V, Section IV), and process equipment leaks (Regulation V, Section XIII).

With regard to Regulation VI, there will be no new air toxic contaminants associated with this Project.

There are no AMS regulations that are significantly different from, or more stringent than, the regulations cited herein. The proposed Project will not result in any additional AMS applicable requirements

## 6.2 FEDERAL NESHAPS (40 CFR PART 63)

The NESHAPS were promulgated after the 1990 Clean Air Act Amendments and require application of technology-based emissions standards for major and area sources of HAP. The PES hazardous air pollutant (HAP) emissions exceed 10 TPY for an individual HAP or 25 TPY for all HAP combined; therefore, it is considered a major source of HAPs.

***Subpart DDDDD***

The proposed PES Tier 3 Project is subject to the National Emission Standards for Hazardous Air Pollutants for Major Sources: Industrial, Commercial, and Institutional Boilers and Process Heaters (Boiler MACT) codified in 40 CFR 63.7490. The existing affected heaters must be in compliance with the Boiler MACT within 180 days of January 31, 2016 and new affected heaters within 180 days of initial startup. PES will demonstrate compliance by performing annual tune-ups of each affected heater and completing a one-time energy assessment for existing heaters.

### 6.3 FEDERAL NSPS (40 CFR PART 60)

Section 111 of the Clean Air Act authorized the EPA to develop technology based standards which apply to specific categories of stationary sources. These standards are referred to as New Source Performance Standards (NSPS). The following subsections highlight the requirements of the applicable NSPSs for the proposed Project.

#### 6.3.1 Replacement Unit 864 PH-13 Heater

Subpart Ja is applicable to new or modified sources in petroleum refineries including: fluid catalytic cracking units (FCCU), fluid coking units (FCU), delayed coking units, fuel gas combustion devices, flares and sulfur recovery plants. The idle Unit 864 PH-13 Heater from the former Sunoco Inc. (R&M) Eagle Point Refinery was subject to NSPS Subpart J at the commencement of operation (prior to the May 14, 2007 NSPS Subpart Ja applicability date) and continued to be subject to Subpart J at the time when the Eagle Point Refinery was idled in the fourth quarter 2009.

Unlike the PSD and NANSR programs, reactivation of an idle source is not considered construction of a new source[6]. The replacement Unit 864 PH-13 Heater would only be subject to NSPS if the source has been modified or reconstructed, where 40 CFR 60.2 defines modification as…

> *"any physical change in, or change in the method of operation of, an existing facility which increases the amount of any air pollutant (to which a standard applies) emitted into the atmosphere by that facility or which results in the emission of any air pollutant (to which a standard applies) into the atmosphere not previously emitted."*

The proposed changes to the Unit 864 Naphtha Hydrotreating Unit do not require physical changes or a change in the method of operation to the replacement Unit 864 PH-13 Heater which increases the amount of any pollutant to which a standard applies. Therefore, the replacement Unit 864 PH-13 Heater is considered subject to Subpart J and is not considered a modified source and therefore, not subject to Subpart Ja.

#### 6.3.2 Unit 870 H-2 Heater

The Unit 870 H-2 Heater will have updated ULNBs installed as part of this Project. However, both the maximum firing capacity (MMBtu/hr) and $NO_x$

[6] Memo from Edward E. Reich, Dir., Div. Of Stationary Source Enf., to Sandra S. Gardebring, Dir., Region V Enf. Div. (Oct. 30, 1980).

emission rate (lb/MMBtu) of the Unit 870 H-2 Heater will be unaffected by the change. The proposed physical change to the Unit 870 H-2 Heater will not result in increases the amount of any pollutant to which a standard applies. Therefore, the Unit 870 H-2 Heater is considered subject to Subpart J and is not considered a modified source and therefore, not subject to Subpart Ja.

### *6.3.3 New Unit 870 H-3 Heater*

The new Unit 870 H-3 Heater is considered a fuel gas combustion device and is subject to Subpart Ja, which includes sulfur and $NO_x$ standards. As per 40 CFR 60.107a(2), PES complies with the hydrogen sulfide ($H_2S$) concentration limits in 60.102a(g)(1)(ii) by continuously monitoring and recording the concentration by volume (dry basis) of $H_2S$ in the refinery fuel gas system.

$NO_x$ emissions limitations apply to natural draft process heaters with a rated capacity greater than 40 MMBtu/hr. The Unit 870 H-3 Heater will subject to the $NO_x$ limit found at 40 CFR §60.102a(g)(2)(i)(B) which is 0.040 lb/MMBtu on a 30-day rolling average basis. The expected $NO_x$ emission rate for the Unit 870 H-3 Heater is 0.03 lb/MMBtu.

As per 40 CFR §60.107a(d), PES will be required install, operate, calibrate and maintain an instrument for continuously monitoring and recording the concentration (dry basis, 0-percent excess air) of $NO_x$ emissions into the atmosphere to comply with the $NO_x$ emissions limit in 40 CFR §60.102a(g)(2)(i)(B). The monitor must also include an oxygen monitor for correcting the data for excess air.

### *6.3.4 Other Affected Heaters*

PES evaluated whether the affected heaters that are experiencing increased utilization (Unit 864 PH-1 Heater, Unit 864 PH-11 Heater, Unit 864 PH-12 Heater, Unit 870 H-1 Heater, and Unit 1332 H-2) as part of the PES Tier 3 Project trigger the applicability of NSPS for affected sources.

The proposed changes to the Unit 864 Naphtha Hydrotreating Unit, Unit 870 LSG Unit, or Unit 1332 Reformer Unit do not require physical changes or capital expenditures on the affected facility (i.e., the heaters) to accommodate the increased utilization. As such, no sources are considered to be modified sources under USEPA's New Source Performance Standards codified under 40 CFR Part 60. Specifically, 40 CFR 60.14(e)(2) excludes from the definition of modification…

> *"an increase in production rate of an existing facility, if that increase can be accomplished without a capital expenditure on that facility."*

The increase in heater utilization sought in this Project represents a production rate increase for the affected heaters. All of the heaters serve the same overall purpose - to produce heated hydrocarbon streams for processing. Additionally, as discussed in published USEPA guidance, both changes in production rate and operating changes are included in the assessment of capital expenditure associated with the project[7].

The increase in utilization of the affected heaters in this Project can be achieved without any capital expenditure. Therefore, the affected heaters are not considered modified sources and therefore are not subject to NSPS.

[7] EPA, 1989. Re: Applicability of NSPS. Letter from Don R. Clay, Acting Assistant EPA Administrator of EPA to Mr. John W. Boston, WEPCO, February 15, 1989.

*Attachment A*
*AMS Plan Approval Application Forms*

# CITY OF PHILADELPHIA

DEPARTMENT OF PUBLIC HEALTH
PUBLIC HEALTH SERVICES
AIR MANAGEMENT SERVICES

Air Management Services
321 University Avenue
Philadelphia PA 19104-4543
Phone: (215) 685-7572
FAX: (215) 685-7593

## APPLICATION FOR PLAN APPROVAL TO CONSTRUCT, MODIFY OR REACTIVATE AN AIR CONTAMINATION SOURCE AND/OR AIR CLEANING DEVICE

***(Prepare all information completely in print or type in triplicate)***

### SECTION A - APPLICATION INFORMATION

| | |
|---|---|
| Location of source ( Street Address)<br>**3144 Passyunk Avenue** | Facility Name<br>**Philadelphia Energy Solutions Refining and Marketing LLC** |
| Owner<br>**Philadelphia Energy Solutions Refining and Marketing LLC** | Tax ID No<br>**61-1689574** |

| | | |
|---|---|---|
| Mailing Address<br>**3144 Passyunk Avenue** | Telephone No.<br>**(215) 339-2074** | Fax No.<br>**(215) 339-2657** |
| Contact Person<br>**Charles D. Barksdale Jr.** | Title<br>**Manager, Environmental Department** | |
| Mailing Address<br>**3144 Passyunk Avenue Philadelphia, PA 19145** | Telephone No.<br>**(215) 339-2074** | Fax No<br>**(215) 339-2657** |

E-mail Address
**CHARLES.BARKSDALE@pes-companies.com**

### SECTION B - DESCRIPTION OF ACTIVITY

| | | |
|---|---|---|
| Application type<br>☒New source ☒Modification ☒Replacement ☐Reactivation ☐Air cleaning device ☐Other____________ | SIC Code<br>**2911** | Completion Date<br>**January 1, 2017** |

| | |
|---|---|
| Applicable requirement<br>☒ NSPS ☒ NESHAP ☐ Case by Case MACT ☒ NSR ☐ PSD | Does Facility submit Compliance Review Form biannually? ☒ Yes ☐ No<br>If No attach Air Pollution Control Act Compliance Review Form with this application. |

Source Description
**PES plans to reconfigure existing process units, re-route intermediate process streams, and expand hydrotreating process capacity to enable compliance with the Tier 3 gasoline standards. This includes the installation of low $NO_x$ burners (LNB) on the Unit 864 PH-1, Unit 864 PH-11, Unit 864 PH-12 refinery fuel gas fired heaters; replacement of the Unit 864 PH-7 Heater with an idle heater from the former Sunoco Inc. (R&M) Eagle Point Refinery; and installation of a new Unit 870 H-3 Heater. For the purposes of this application, the project is referred to as the "PES Tier 3 Project".**

### SECTION C - PERMIT COORDINATION (ONLY REQUIRED FOR LAND DEVELOPMENT)

| Question | YES | NO |
|---|---|---|
| 1. Will the project involve construction activity that disturbs five or more acres of land? | | X |
| 2. Will the project involve discharge of industrial wastewater or stormwater to a dry swale, surface water, ground water or an existing sanitary sewer system? | | X |
| 3. Will the project involve the construction and operation of industrial waste treatment facility? | | X |
| 4. Is onsite sewage disposal proposed for your project? | | X |
| 5. Will the project involve construction of sewage treatment facilities, sanitary sewer, or sewage pumping station? | | X |
| 6. Is a stormwater collection and discharge system proposed for this project? | | X |
| 7. Will any work associated with this project take place in or near a stream, waterway, or wetland? | | X |
| 8. Does the project involve dredging or construction of any dam, pier, bridge or outfall pipe? | | X |
| 9. Will any solid waste or liquid wastes be generated as a result of the project? | X | |
| 10. Is a State Park located within two miles from your project? | | X |

### SECTION D - CERTIFICATION

**I certify that I have the authority to submit this Permit Application on behalf of the applicant named herein and that the information provided in this application is true and correct to the best of my knowledge and information.**

Signature _________________________ Date__________ Address____________**3144 Passyunk Avenue, Philadelphia, PA 19145**_________________

Name & Title_____________________________________________________ Phone______________________ Fax_____________________________

### SECTION E - OFFICIAL USE ONLY

| Application No. | Plant ID | Health District | Census Tract | Fee | Date Received |
|---|---|---|---|---|---|
| | | | | | |

| Approved by | Date | Conformance by | Date |
|---|---|---|---|
| | | | |

## SECTION F 1 - GENERAL SOURCE INFORMATION

| | 1. SOURCE | | | | | 2. NORMAL PROCESS OPERATING SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A. Type Source (Describe) | B. Manufacturer of Source | C. Model No. | D. Rated Capacity (Specify units) | E. Type of Materials Processed | A. Amount Processed/yr. (Specify units) | B. Average hr/day | C. Total hr/yr | D. % Throughput/Quarter 1st | 2nd | 3rd | 4th |
| **1** | **Unit 864 PH-13 Heater (See attached report)** | **N/A** | **N/A** | **70.0 MMBtu/hr** | | | | | | | | |
| **2** | **Unit 864 PH-1 Heater (See attached report)** | **N/A** | **N/A** | **74.9 MMBtu/hr** | | | | | | | | |
| **3** | **Unit 864 PH-11 Heater (See attached report)** | **N/A** | **N/A** | **74.0 MMBtu/hr** | | | | | | | | |
| **4** | **Unit 864 PH-12 Heater (See attached report)** | **N/A** | **N/A** | **85.1 MMBtu/hr** | | | | | | | | |
| **5** | **Unit 870 H-3 Heater (See attached report)** | **N/A** | **N/A** | **110.0 MMBtu/hr** | | | | | | | | |
| **6** | **See attached report for affected sources.** | | | | | | | | | | | |

| 3. ESTIMATED FUEL USAGE (Specify Units) | | | | | | | 4. ANNUAL FUEL USAGE | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **A. Used in Unit** | B. Type Fuel | C. Average Hourly Rate | D. Maximum Hourly Rate | E. Percent Sulfur | F. Percent Ash | G. Heating Value | A. Annual Amounts | B. Average hr/day | C. Total hr/yr | D. % Throughput/Quarter 1st | 2nd | 3rd | 4th |
| **Unit 864 PH-13 Heater** | **Refinery Fuel Gas** | | **70.0 MMBtu/hr** | | | **1028 Btu/scf** | | **24 hr/day** | **8760 hr/yr** | | | | |
| **Unit 864 PH-1 Heater** | **Refinery Fuel Gas** | | **74.9 MMBtu/hr** | | | **1028 Btu/scf** | | **24 hr/day** | **8760 hr/yr** | | | | |
| **Unit 864 PH-11 Heater** | **Refinery Fuel Gas** | | **74.0 MMBtu/hr** | | | **1028 Btu/scf** | | **24 hr/day** | **8760 hr/yr** | | | | |
| **Unit 864 PH-12 Heater** | **Refinery Fuel Gas** | | **85.1 MMBtu/hr** | | | **1028 Btu/scf** | | **24 hr/day** | **8760 hr/yr** | | | | |
| **Unit 870 H-3 Heater** | **Refinery Fuel Gas** | | **110.0 MMBtu/hr** | | | **1028 Btu/scf** | | **24 hr/day** | **8760 hr/yr** | | | | |
| | **See attached report for affected sources.** | | | | | | | | | | | | |

**5. IMPORTANT: Attach on a separate sheet a flow diagram of process giving all (gaseous, liquid, and solid) flow rates . Also list raw materials charged to process equipment and the amounts charged (tons/hour, etc.) at rated capacity (give maximum, minimum and average charges describing fully expected variations in production rates). Indicate (on diagram) all points where contaminants are controlled (location of water sprays, hoods or other pickup points, etc.).**

## SECTION F 1 - GENERAL SOURCE INFORMATION, CONTINUED

6. Describe process equipments in detail.

**Relevant process equipment include refinery fuel gas fired heaters, a recirculating cooling tower, the Unit 867 Sulfur Recovery Unit, and fugitive emission components.**

**See the attached report for additional details.**

7. Describe fully the methods used to monitor and record all operating conditions that may affect the emission of air contaminants. Provide detailed information to show that these methods provided are adequate.

**PES will be replacing the existing Unit 864 PH-7 heater (nominal firing duty of 45.0 MMBtu/hr) with an existing idle heater (LSG H-1) located at the former Sunoco Inc. (R&M) Eagle Point Refinery in New Jersey. The replacement heater will be designated Unit 864 PH-13. This replacement heater is equipped with ULNB that will achieve a $NO_x$ emission rate of 0.02 lb/MMBtu. PES will also be installing a new refinery fuel gas fired heater designated Unit 870 H-3 (nominal firing duty of 110.0 MMBtu/hr) and will be equipped with ULNB that will achieve a $NO_x$ emission rate of 0.03 lb/MMBtu. Lastly, as part of the Project, PES has elected to install LNB on the Unit 864 PH-1, Unit 864 PH-11, and Unit 864 PH-12 heaters that will achieve a $NO_x$ emission rate of 0.06 lb/MMBtu.**

**See the attached report for additional details.**

8. Describe modifications to process equipments in detail.

**See the attached report for additional details.**

9. Attach any and all additional information necessary to adequately describe the process equipment and to perform a thorough evaluation of the extent and nature of its emissions.

**See the attached report that includes a BAT analysis.**

- Provide equipment information on this page if sources do not belong to special categories in F2 to F8, otherwise remove this page from this application.
- If there are more equipment, copy this page and fill in the information as indicated

## SECTION F 2 - COMBUSTION UNITS INFORMATION

1. COMBUSTION UNITS **– See the attached report sections**.

| | | |
|---|---|---|
| A. Manufacturer<br>**Not applicable** | B. Model No.<br>**Not applicable** | C. Unit No.<br>**Unit 864 PH-13 Heater** |
| D. Rated heat input (Btu/hr)<br>**70.0 MMBtu/hr** | E. Peak heat input (Btu/hr) | F. Use<br>**Process heat** |

G. Method firing

☐ Pulverized ☐ Spreader Stoker ☐ Cyclone ☐ Tangential ☒ Normal ☐ Fluidized bed ☐ Other _______________

2. FUEL REQUIREMENTS

| TYPE | *QUANTITY HOURLY* | *QUANTITY ANNUALLY* | *SULFUR* | *ASH* | *BTU CONTENT* |
|---|---|---|---|---|---|
| OIL NUMBER<br>_____________ | GPH at $60\ ^0F$ | $x10^3$ Gal. | % by wt. | % by wt. | Btu/Gal. & lbs/Gal. @ 60°F |
| NATURAL GAS | SCFH | $x10^6$ SCF | gr/100 SCF | | Btu/SCF |
| OTHER<br>_**Refinery Fuel Gas**____________ | **68.1 MSCFH** | | **162 ppmv $H_2S$ maximum** | | **1,028 Btu/SCF** |

3. COMBUSTION AIDS, CONTROLS, AND MONITORS

| | | | |
|---|---|---|---|
| ☐ A. Overfire jets | Type | Number | Height above grate |
| ☐ B. Draft controls | Type | | |
| ☐ C. Oil preheat | | | |
| ☐ D. Soot cleaning | Temperature ($^oF$) | Frequency | |
| ☐ E. Stack sprays | Method | | |
| ☐ F. Opacity monitoring device | | Method | Cost |
| ☐ G. Sulfur oxides monitoring device | Type | Method | Cost |
| ☐ H. Nitrogen oxides monitoring device | Type | Method | Cost |
| ☐ I. Fuel metering and/or recording devices | Type | Method | Cost |
| ☐ J. Atomization interlocking device | Type | Method | Cost |
| ☐ K. Collected flyash reentrainment preventative device | Type | | |

☐ L. Modulating controls ☐ Step

☐ Automatic

4. ☐ Flyash reinjection. (Describe operation)

5. Describe method of supplying make up air to the furnace room.

Section F 2 - Combustion Units Information, Continued

- Use this page for Degreaser, otherwise remove this page from this application.
- If you have more units, copy this page and fill in the information as indicated

6. OPERATING SCHEDULE

_____**24**_______________ hours/day _______**7**_____________ days/week ______**52**______________ weeks/year

7. SEASONAL PERIODS (MONTHS)

Operating using primary fuel ____________________ Operating using secondary fuel ____________________

____________________ to ____________________ ____________________ to ____________________

Non-operating

____________________ to ____________________

8. If heat input is in excess of 250 x 10 6 Btu/hr., describe fully the methods used to record the following: rate of fuel burned; heating value, sulfur and ash content of fuels; smoke, sulfur oxides and nitrogen oxides emissions; and if electric generating plant, the average electrical output and the minimum and maximum hourly generation rate.

**PES will continue to monitor, record, and report with applicable requirements found in the Philadelphia Refinery's existing Title V permit and the Consent Decree.**

9. Describe modifications to boiler in detail.

**See the attached report sections.**

10. Type and method of disposal of all waste materials generated by this boiler.

(Is a Solid Waste Disposal Permit needed? ☐ Yes ☒ No)

11. Briefly describe the method of handling the waste water from this boiler and its associated air pollution control equipment.

(Is a Water quality Management Permit needed? ☐ Yes ☒ No)

12. Attach any and all additional information necessary to perform a thorough evaluation of this boiler.

**See the attached report sections.**

- Use this page for Degreaser, otherwise remove this page from this application.
- If you have more units, copy this page and fill in the information as indicated

## SECTION F 2 - COMBUSTION UNITS INFORMATION

1. COMBUSTION UNITS **– See the attached report sections**.

| A. Manufacturer | B. Model No. | C. Unit No. |
|---|---|---|
| **Not applicable** | **Not applicable** | **Unit 864 PH-1 Heater** |
| D. Rated heat input (Btu/hr) | E. Peak heat input (Btu/hr) | F. Use |
| **74.9 MMBtu/hr** | | **Process heat** |

G. Method firing

☐ Pulverized ☐ Spreader Stoker ☐ Cyclone ☐ Tangential ☒ Normal ☐ Fluidized bed ☐ Other _______________

2. FUEL REQUIREMENTS

| TYPE | *QUANTITY HOURLY* | *QUANTITY ANNUALLY* | *SULFUR* | *ASH* | *BTU CONTENT* |
|---|---|---|---|---|---|
| OIL NUMBER _____________ | GPH at 60 $^0$F | x10$^3$ Gal. | % by wt. | % by wt. | Btu/Gal. & lbs/Gal. @ 60°F |
| NATURAL GAS | SCFH | x10$^6$ SCF | gr/100 SCF | | Btu/SCF |
| OTHER _**Refinery Fuel Gas**____________ | **72.9 MSCFH** | | **162 ppmv $H_2S$ maximum** | | **1,028 Btu/SCF** |

3. COMBUSTION AIDS, CONTROLS, AND MONITORS

| | | | |
|---|---|---|---|
| ☐ A. Overfire jets | Type | Number | Height above grate |
| ☐ B. Draft controls | Type | | |
| ☐ C. Oil preheat | | | |
| ☐ D. Soot cleaning | Temperature ($^o$F) | Frequency | |
| ☐ E. Stack sprays | Method | | |
| ☐ F. Opacity monitoring device | | Method | Cost |
| ☐ G. Sulfur oxides monitoring device | Type | Method | Cost |
| ☐ H. Nitrogen oxides monitoring device | Type | Method | Cost |
| ☐ I. Fuel metering and/or recording devices | Type | Method | Cost |
| ☐ J. Atomization interlocking device | Type | Method | Cost |
| ☐ K. Collected flyash reentrainment preventative device | Type | | |

☐ L. Modulating controls ☐ Step

☐ Automatic

4. ☐ Flyash reinjection. (Describe operation)

5. Describe method of supplying make up air to the furnace room.

- Use this page for Degreaser, otherwise remove this page from this application.
- If you have more units, copy this page and fill in the information as indicated

## SECTION F 2 - COMBUSTION UNITS INFORMATION, CONTINUED

6. OPERATING SCHEDULE

_____**24**__ hours/day _______**7**_______ days/week ______**52**______ weeks/year

7. SEASONAL PERIODS (MONTHS)

Operating using primary fuel ____________________ Operating using secondary fuel ____________________

____________________ to ____________________ ____________________ to ____________________

Non-operating

____________________ to ____________________

8. If heat input is in excess of 250 x $10^6$ Btu/hr., describe fully the methods used to record the following: rate of fuel burned; heating value, sulfur and ash content of fuels; smoke, sulfur oxides and nitrogen oxides emissions; and if electric generating plant, the average electrical output and the minimum and maximum hourly generation rate.

**PES will continue to monitor, record, and report with applicable requirements found in the Philadelphia Refinery's existing Title V permit and the Consent Decree.**

9. Describe modifications to boiler in detail.

**See the attached report sections.**

10. Type and method of disposal of all waste materials generated by this boiler.
(Is a Solid Waste Disposal Permit needed? ☐ Yes ☒ No)

11. Briefly describe the method of handling the waste water from this boiler and its associated air pollution control equipment.
(Is a Water quality Management Permit needed? ☐ Yes ☒ No)

12. Attach any and all additional information necessary to perform a thorough evaluation of this boiler.

**See the attached report sections.**

- Use this page for Degreaser, otherwise remove this page from this application.
- If you have more units, copy this page and fill in the information as indicated

## SECTION F 2 - COMBUSTION UNITS INFORMATION

1. COMBUSTION UNITS **– See the attached report sections**.

| A. Manufacturer | B. Model No. | C. Unit No. |
|---|---|---|
| **Not applicable** | **Not applicable** | **Unit 864 PH-11 Heater** |
| D. Rated heat input (Btu/hr) | E. Peak heat input (Btu/hr) | F. Use |
| **74.0 MMBtu/hr** | | **Process heat** |

G. Method firing

☐ Pulverized ☐ Spreader Stoker ☐ Cyclone ☐ Tangential ☒ Normal ☐ Fluidized bed ☐ Other _______________

2. FUEL REQUIREMENTS

| TYPE | *QUANTITY HOURLY* | *QUANTITY ANNUALLY* | *SULFUR* | *ASH* | *BTU CONTENT* |
|---|---|---|---|---|---|
| OIL NUMBER _____________ | GPH at 60 $^{0}$F | x10$^{3}$ Gal. | % by wt. | % by wt. | Btu/Gal. & lbs/Gal. @ 60°F |
| NATURAL GAS | SCFH | x10$^{6}$ SCF | gr/100 SCF | | Btu/SCF |
| OTHER _**Refinery Fuel Gas**____________ | **72.0 MSCFH** | | **162 ppmv $H_2S$ maximum** | | **1,028 Btu/SCF** |

3. COMBUSTION AIDS, CONTROLS, AND MONITORS

| | | | |
|---|---|---|---|
| ☐ A. Overfire jets | Type | Number | Height above grate |
| ☐ B. Draft controls | Type | | |
| ☐ C. Oil preheat | | | |
| ☐ D. Soot cleaning | Temperature ($^{o}$F) | Frequency | |
| ☐ E. Stack sprays | Method | | |
| ☐ F. Opacity monitoring device | | Method | Cost |
| ☐ G. Sulfur oxides monitoring device | Type | Method | Cost |
| ☐ H. Nitrogen oxides monitoring device | Type | Method | Cost |
| ☐ I. Fuel metering and/or recording devices | Type | Method | Cost |
| ☐ J. Atomization interlocking device | Type | Method | Cost |
| ☐ K. Collected flyash reentrainment preventative device | Type | | |

☐ L. Modulating controls ☐ Step

☐ Automatic

4. ☐ Flyash reinjection. (Describe operation)

5. Describe method of supplying make up air to the furnace room.

- Use this page for Degreaser, otherwise remove this page from this application.
- If you have more units, copy this page and fill in the information as indicated

## SECTION F 2 - COMBUSTION UNITS INFORMATION, CONTINUED

6. OPERATING SCHEDULE

_____**24__**_____________ hours/day   ________**7**_____________ days/week   _______**52**______________ weeks/year

7. SEASONAL PERIODS (MONTHS)

Operating using primary fuel ____________________   Operating using secondary fuel ____________________

____________________ to ____________________   ____________________ to ____________________

Non-operating

____________________ to ____________________

8. If heat input is in excess of 250 x $10^6$ Btu/hr., describe fully the methods used to record the following: rate of fuel burned; heating value, sulfur and ash content of fuels; smoke, sulfur oxides and nitrogen oxides emissions; and if electric generating plant, the average electrical output and the minimum and maximum hourly generation rate.

**PES will continue to monitor, record, and report with applicable requirements found in the Philadelphia Refinery's existing Title V permit and the Consent Decree.**

9. Describe modifications to boiler in detail.

**See the attached report sections.**

10. Type and method of disposal of all waste materials generated by this boiler.
(Is a Solid Waste Disposal Permit needed? ☐ Yes ☒ No)

11. Briefly describe the method of handling the waste water from this boiler and its associated air pollution control equipment.
(Is a Water quality Management Permit needed? ☐ Yes ☒ No)

12. Attach any and all additional information necessary to perform a thorough evaluation of this boiler.

**See the attached report sections.**

- Use this page for Degreaser, otherwise remove this page from this application.
- If you have more units, copy this page and fill in the information as indicated

## SECTION F 2 - COMBUSTION UNITS INFORMATION

1. COMBUSTION UNITS **– See the attached report sections**.

| A. Manufacturer | B. Model No. | C. Unit No. |
|---|---|---|
| **Not applicable** | **Not applicable** | **Unit 864 PH-12 Heater** |
| D. Rated heat input (Btu/hr) | E. Peak heat input (Btu/hr) | F. Use |
| **85.1 MMBtu/hr** | | **Process heat** |

G. Method firing

☐ Pulverized ☐ Spreader Stoker ☐ Cyclone ☐ Tangential ☒ Normal ☐ Fluidized bed ☐ Other _______________

2. FUEL REQUIREMENTS

| TYPE | *QUANTITY HOURLY* | *QUANTITY ANNUALLY* | *SULFUR* | *ASH* | *BTU CONTENT* |
|---|---|---|---|---|---|
| OIL NUMBER _____________ | GPH at 60 $^{0}$F | x$10^3$ Gal. | % by wt. | % by wt. | Btu/Gal. & lbs/Gal. @ 60°F |
| NATURAL GAS | SCFH | x$10^6$ SCF | gr/100 SCF | | Btu/SCF |
| OTHER _**Refinery Fuel Gas**_____________ | **82.8 MSCFH** | | **162 ppmv $H_2S$ maximum** | | **1,028 Btu/SCF** |

3. COMBUSTION AIDS, CONTROLS, AND MONITORS

| | | | |
|---|---|---|---|
| ☐ A. Overfire jets | Type | Number | Height above grate |
| ☐ B. Draft controls | Type | | |
| ☐ C. Oil preheat | | | |
| ☐ D. Soot cleaning | Temperature ($^{o}$F) | Frequency | |
| ☐ E. Stack sprays | Method | | |
| ☐ F. Opacity monitoring device | | Method | Cost |
| ☐ G. Sulfur oxides monitoring device | Type | Method | Cost |
| ☐ H. Nitrogen oxides monitoring device | Type | Method | Cost |
| ☐ I. Fuel metering and/or recording devices | Type | Method | Cost |
| ☐ J. Atomization interlocking device | Type | Method | Cost |
| ☐ K. Collected flyash reentrainment preventative device | Type | | |
| ☐ L. Modulating controls | ☐ Step<br>☐ Automatic | | |

4. ☐ Flyash reinjection. (Describe operation)

5. Describe method of supplying make up air to the furnace room.

- Use this page for Degreaser, otherwise remove this page from this application.
- If you have more units, copy this page and fill in the information as indicated

## SECTION F 2 - COMBUSTION UNITS INFORMATION, CONTINUED

6. OPERATING SCHEDULE

_____**24__**_____________ hours/day     ________**7**_____________ days/week     _______**52**______________ weeks/year

7. SEASONAL PERIODS (MONTHS)

Operating using primary fuel ____________________     Operating using secondary fuel ____________________

____________________ to ____________________     ____________________ to ____________________

Non-operating

____________________ to ____________________

8. If heat input is in excess of 250 x $10^6$ Btu/hr., describe fully the methods used to record the following: rate of fuel burned; heating value, sulfur and ash content of fuels; smoke, sulfur oxides and nitrogen oxides emissions; and if electric generating plant, the average electrical output and the minimum and maximum hourly generation rate.

**PES will continue to monitor, record, and report with applicable requirements found in the Philadelphia Refinery's existing Title V permit and the Consent Decree.**

9. Describe modifications to boiler in detail.

**See the attached report sections.**

10. Type and method of disposal of all waste materials generated by this boiler.
(Is a Solid Waste Disposal Permit needed? ☐ Yes ☒ No)

11. Briefly describe the method of handling the waste water from this boiler and its associated air pollution control equipment.
(Is a Water quality Management Permit needed? ☐ Yes ☒ No)

12. Attach any and all additional information necessary to perform a thorough evaluation of this boiler.

**See the attached report sections.**

- Use this page for Degreaser, otherwise remove this page from this application.
- If you have more units, copy this page and fill in the information as indicated

## SECTION F 2 - COMBUSTION UNITS INFORMATION

1. COMBUSTION UNITS **– See the attached report sections**.

| | | |
|---|---|---|
| A. Manufacturer<br>**Not applicable** | B. Model No.<br>**Not applicable** | C. Unit No.<br>**Unit 870 H-3 Heater** |
| D. Rated heat input (Btu/hr)<br>**110.0 MMBtu/hr** | E. Peak heat input (Btu/hr) | F. Use<br>**Process heat** |

G. Method firing

☐ Pulverized ☐ Spreader Stoker ☐ Cyclone ☐ Tangential ☒ Normal ☐ Fluidized bed ☐ Other _______________

2. FUEL REQUIREMENTS

| TYPE | *QUANTITY HOURLY* | *QUANTITY ANNUALLY* | *SULFUR* | *ASH* | *BTU CONTENT* |
|---|---|---|---|---|---|
| OIL NUMBER _____________ | GPH at 60 $^0$F | x10$^3$ Gal. | % by wt. | % by wt. | Btu/Gal. & lbs/Gal. @ 60°F |
| NATURAL GAS | SCFH | x10$^6$ SCF | gr/100 SCF | | Btu/SCF |
| OTHER _**Refinery Fuel Gas**____________ | **107.0 MSCFH** | | **162 ppmv $H_2S$ maximum** | | **1,028 Btu/SCF** |

3. COMBUSTION AIDS, CONTROLS, AND MONITORS

| | | | |
|---|---|---|---|
| ☐ A. Overfire jets | Type | Number | Height above grate |
| ☐ B. Draft controls | Type | | |
| ☐ C. Oil preheat | | | |
| ☐ D. Soot cleaning | Temperature ($^o$F) | Frequency | |
| ☐ E. Stack sprays | Method | | |
| ☐ F. Opacity monitoring device | | Method | Cost |
| ☐ G. Sulfur oxides monitoring device | Type | Method | Cost |
| ☒ H. Nitrogen oxides monitoring device | Type – **CEMS** | Method - **Chemiluminescence** | Cost |
| ☐ I. Fuel metering and/or recording devices | Type | Method | Cost |
| ☐ J. Atomization interlocking device | Type | Method | Cost |
| ☐ K. Collected flyash reentrainment preventative device | Type | | |

☐ L. Modulating controls ☐ Step ☐ Automatic

4. ☐ Flyash reinjection. (Describe operation)

5. Describe method of supplying make up air to the furnace room.

- Use this page for Degreaser, otherwise remove this page from this application.
- If you have more units, copy this page and fill in the information as indicated

## SECTION F 2 - COMBUSTION UNITS INFORMATION, CONTINUED

6. OPERATING SCHEDULE

_____**24**__ hours/day ________**7**_____ days/week _______**52**_______ weeks/year

7. SEASONAL PERIODS (MONTHS)

Operating using primary fuel ____________________ Operating using secondary fuel ____________________

____________________ to ____________________ ____________________ to ____________________

Non-operating

____________________ to ____________________

8. If heat input is in excess of 250 x $10^6$ Btu/hr., describe fully the methods used to record the following: rate of fuel burned; heating value, sulfur and ash content of fuels; smoke, sulfur oxides and nitrogen oxides emissions; and if electric generating plant, the average electrical output and the minimum and maximum hourly generation rate.

**PES will continue to monitor, record, and report with applicable requirements found in the Philadelphia Refinery's existing Title V permit and the Consent Decree.**

9. Describe modifications to boiler in detail.

**See the attached report sections.**

10. Type and method of disposal of all waste materials generated by this boiler.
(Is a Solid Waste Disposal Permit needed? ☐ Yes ☒ No)

11. Briefly describe the method of handling the waste water from this boiler and its associated air pollution control equipment.
(Is a Water quality Management Permit needed? ☐ Yes ☒ No)

12. Attach any and all additional information necessary to perform a thorough evaluation of this boiler.

**See the attached report sections.**

- Use this page for Degreaser, otherwise remove this page from this application.
- If you have more units, copy this page and fill in the information as indicated

## SECTION G - FLUE AND AIR CONTAMINANT EMISSION INFORMATION

1. STACK AND EXHAUSTER

**Unit 864 PH-13 Heater Stack**

A. Outlet volume of exhaust gases

______**19,612**___________ CFM @___**424**___ °F_____ % Moisture

B, Exhauster (attach fan curves)

___________ in w.g. _________________ HP @ ____________________ RPM

C . Stack height above grade (ft) __**152.5**___

Grade elevation (ft) __________

Distance from discharge to nearest property line(ft) __________

D Stack diameter (ft) or Outlet duct area (sq. ft.)

**5.92 feet (71 inches)**

E Weather Cap

☐ YES ☒ NO

F. Indicate on an attached sheet the location of sampling ports with respect to exhaust fan, breeching, etc. Give all necessary dimensions.

**To be determined.**

2 POTENTIAL PROCESS EMISSIONS (OUTLET FROM PROCESS, BEFORE ANY CONTROL EQUIPMENT)

**See the attached report sections.**

A. Particulate loading (lbs/hr or gr/DSCF)

B. Specific gravity of particulate (not bulk density)

C . Attached particle size distribution information

D. Specify gaseous contaminants and concentration

| Contaminant | Concentration | | VOC Contaminants | Concentration | |
|---|---|---|---|---|---|
| (1) $SO_x$ | _________ ppm (Vol.) | _________ lbs/hr | (4) __________ | _________ ppm (Vol.) | _________ lbs/hr |
| (2) $NO_x$ | _________ ppm (Vol.) | _________ lbs/hr | (5) __________ | _________ ppm (Vol.) | _________ lbs/hr |
| (3) CO | _________ ppm (Vol.) | _________ lbs/hr | (6) __________ | _________ ppm (Vol.) | _________ lbs/hr |

E. Does process vent through the control device ? ☐ YES ☒ NO

- If YES continue and fill out the appropriate SECTION H - CONTROL EQUIPMENT
- If NO skip to SECTION I - MISCELLANEOUS INFORMATION

F. Can the control equipment be bypassed: (If Yes, explain) ☐ YES ☒ NO

3. ATMOSPHERIC EMISSIONS

A. Particulate matter emissions (lbs/hr or gr/DSCF)

**See the attached report sections.**

B. Gaseous contaminant emissions

| Contaminants | Concentration | | VOC Contaminants | Concentration | |
|---|---|---|---|---|---|
| (1) $SO_X$ | __________ ppm (Vol.) | __________ lbs/hr | (4) ______________ | _________ ppm (Vol.) | __________ lbs/hr |
| (2) $NO_X$ | _________ ppm (Vol.) | __________ lbs/h | (5) ______________ | _________ ppm (Vol.) | __________ lbs/hr |
| (3) CO | __________ ppm (Vol.) | __________ lbs/h) | (6) ____ __________ | _________ ppm (Vol.) | __________ lbs/hr |

**See the attached report sections.**

| SECTION H - CONTROL EQUIPMENT, CONTINUED |
|---|
| 12. COSTS – **See the attached report sections.** |
| A. List costs associated with control equipment. (List individual controls separately)<br><br>Control Equipment Cost:<br><br>Direct Cost:<br><br>Indirect Cost: |
| B. Estimated annual operating costs of control equipment only. |
| 13. Describe modifications to control equipment in detail.<br><br>**Not applicable.** |
| 14. Describe in detail the method of dust removal from the air cleaning and methods of controlling fugitive emissions from dust removal, handling and disposal.<br><br>**Not applicable.** |
| 15. Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If so, describe.<br><br>**Not applicable.** |
| 16. Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system). |
| 17. Attach the maintenance schedule for the control equipment and any part of the process equipment that if in disrepair would increase the air contaminant emissions. Periodic maintenance reports are to be submitted to the Department.<br><br>**Maintenance will continue to be provided as per the manufacturer's recommendations and the Title V Permit.** |
| 18. Attach any and all additional information necessary to thoroughly evaluate the control equipment.<br><br>**See the attached report sections.** |

- Provide control equipment information on this page if it pertains to this application, otherwise remove this page from the application.
- If there are more of the same type of control equipment, copy that page and fill in the information as indicated.
- Control equipment can be found from a manufacturer catalogue or vendors.

## SECTION G - FLUE AND AIR CONTAMINANT EMISSION INFORMATION

1. STACK AND EXHAUSTER

**Unit 870 H-3 Heater Stack**

A. Outlet volume of exhaust gases

**27,000** CFM @ **425** °F **0** % Moisture

B, Exhauster (attach fan curves)

___________ in w.g. _________________ HP @ ____________________ RPM

C . Stack height above grade (ft) **150 feet**

Grade elevation (ft) __________

Distance from discharge to nearest property line(ft) __________

D Stack diameter (ft) or Outlet duct area (sq. ft.)

**6.0 feet**

E Weather Cap

☐ YES ☒ NO

F. Indicate on an attached sheet the location of sampling ports with respect to exhaust fan, breeching, etc. Give all necessary dimensions.

**To be determined.**

2 POTENTIAL PROCESS EMISSIONS (OUTLET FROM PROCESS, BEFORE ANY CONTROL EQUIPMENT)

**See the attached report sections.**

A. Particulate loading (lbs/hr or gr/DSCF)

B. Specific gravity of particulate (not bulk density)

C . Attached particle size distribution information

D. Specify gaseous contaminants and concentration

| Contaminant | | Concentration | | VOC Contaminants | | Concentration | |
|---|---|---|---|---|---|---|---|
| (1) | $SO_x$ | _________ ppm (Vol.) | _________ lbs/hr | (4) | __________ | _________ ppm (Vol.) | _________ lbs/hr |
| (2) | $NO_x$ | _________ ppm (Vol.) | _________ lbs/hr | (5) | __________ | _________ ppm (Vol.) | _________ lbs/hr |
| (3) | CO | _________ ppm (Vol.) | _________ lbs/hr | (6) | __________ | _________ ppm (Vol.) | _________ lbs/hr |

E. Does process vent through the control device ? ☐ YES ☒ NO

- If YES continue and fill out the appropriate SECTION H - CONTROL EQUIPMENT
- If NO skip to SECTION I - MISCELLANEOUS INFORMATION

F. Can the control equipment be bypassed: (If Yes, explain) ☐ YES ☒ NO

3. ATMOSPHERIC EMISSIONS

A. Particulate matter emissions (lbs/hr or gr/DSCF)

**See the attached report sections.**

B. Gaseous contaminant emissions

| Contaminants | Concentration | | VOC Contaminants | Concentration | |
|---|---|---|---|---|---|
| (1) $SO_X$ | __________ ppm (Vol.) | __________ lbs/hr | (4) ______________ | _________ ppm (Vol.) | __________ lbs/hr |
| (2) $NO_X$ | _________ ppm (Vol.) | __________ lbs/h | (5) ______________ | _________ ppm (Vol.) | __________ lbs/hr |
| (3) CO | __________ ppm (Vol.) | __________ lbs/h) | (6) ____ __________ | _________ ppm (Vol.) | __________ lbs/hr |

**See the attached report sections.**

- Provide control equipment information on this page if it pertains to this application, otherwise remove this page from the application.
- If there are more of the same type of control equipment, copy that page and fill in the information as indicated.
- Control equipment can be found from a manufacturer catalogue or vendors.

## SECTION H - CONTROL EQUIPMENT, CONTINUED

12. COSTS – **See the attached report sections.**

A. List costs associated with control equipment. (List individual controls separately)

Control Equipment Cost:

Direct Cost:

Indirect Cost:

B. Estimated annual operating costs of control equipment only.

13. Describe modifications to control equipment in detail.

**Not applicable.**

14. Describe in detail the method of dust removal from the air cleaning and methods of controlling fugitive emissions from dust removal, handling and disposal.

**Not applicable.**

15. Does air cleaning device employ hopper heaters, hopper vibrators or hopper level detectors? If so, describe.

**Not applicable.**

16. Attach manufacturer's performance guarantees and/or warranties for each of the major components of the control system (or complete system).

17. Attach the maintenance schedule for the control equipment and any part of the process equipment that if in disrepair would increase the air contaminant emissions. Periodic maintenance reports are to be submitted to the Department.

**Maintenance will be provided as per the manufacturer's recommendations and the Title V Permit.**

18. Attach any and all additional information necessary to thoroughly evaluate the control equipment.

**See the attached report sections.**

- Provide control equipment information on this page if it pertains to this application, otherwise remove this page from the application.
- If there are more of the same type of control equipment, copy that page and fill in the information as indicated.
- Control equipment can be found from a manufacturer catalogue or vendors.

## SECTION I - MISCELLANEOUS INFORMATION

1. Specify monitoring and recording devices will be used for monitoring and recording of the emission of air contaminants. Provide detailed information to show that the facilities provided are adequate. Include cost and maintenance information.

| | | |
|---|---|---|
| ☐ Opacity monitoring system | ☐ SOx monitoring system | ☒ NOx monitoring system |
| ☐ CO monitoring system | ☐ $CO_2$ monitoring system | ☒ Oxygen monitoring system |
| ☐ HCL monitoring system | ☐ TRS monitoring system | ☐ $H_2S$ monitoring system |
| ☐ Temperature monitoring system | ☐ Stack flow monitoring system | ☐ Other __________ |

If checked, provide manufacturer's name, model no. and pertinent technical specifications.

**No changes proposed from existing monitoring, as outlined in existing Title V Permit. The new Unit 870 H-3 Heater will have a continuous monitor installed to monitor the NOx and oxygen concentration in the heater stack that complies with NSPS Subpart Ja requirements (expected to be similar to Rosemount Model 951C Chemiluminescence).**

2. Attach Air Pollution Episode Strategy (if applicable)

**Not applicable.**

3. If the source is subject to 25 Pa. Code Subchapter E, New Source Review requirements,

a. Demonstrate the availability of emission offset (if applicable)

**PES will review the Department's Emission Reduction Credit Registry System to obtain the necessary $NO_x$ and VOC offsets for this project. PES plans to use a portion of the remaining $NO_x$ emission reduction credits (ERCs) generated from the shutdown of certain emissions sources at Marcus Hook as $NO_x$ offsets. The offsets will be surrendered prior to commencement of operation of the affected sources in the manner at which is sought in this plan approval application.**

b. Provide an analysis of alternate sites, sizes, production processes and environmental control techniques demonstrating that the benefits of the proposed source outweigh the environmental and social costs.

**Not applicable.**

**See the attached report sections for details.**

4. Attach calculations and any additional information necessary to thoroughly evaluate compliance with all the applicable requirements of Article III of the rules and regulations of Philadelphia Air Management, Pennsylvania Department of Environmental Protection and those requirements promulgated by the Administrator of the United States Environmental Protection Agency pursuant to the provisions of the Clean Air Act.

**See the attached report sections.**

5. List all attachments included in this Application.

A AMS Plan Approval Application Forms
B Site Location Map/Process Flow Diagrams
C Back-up Emissions Calculations
D Contemporaneous Emissions Tables
E Best Available Technology NOx Control Cost Effectiveness Calculations

*Attachment B*
*Site Location Map/Process Flow Diagrams*

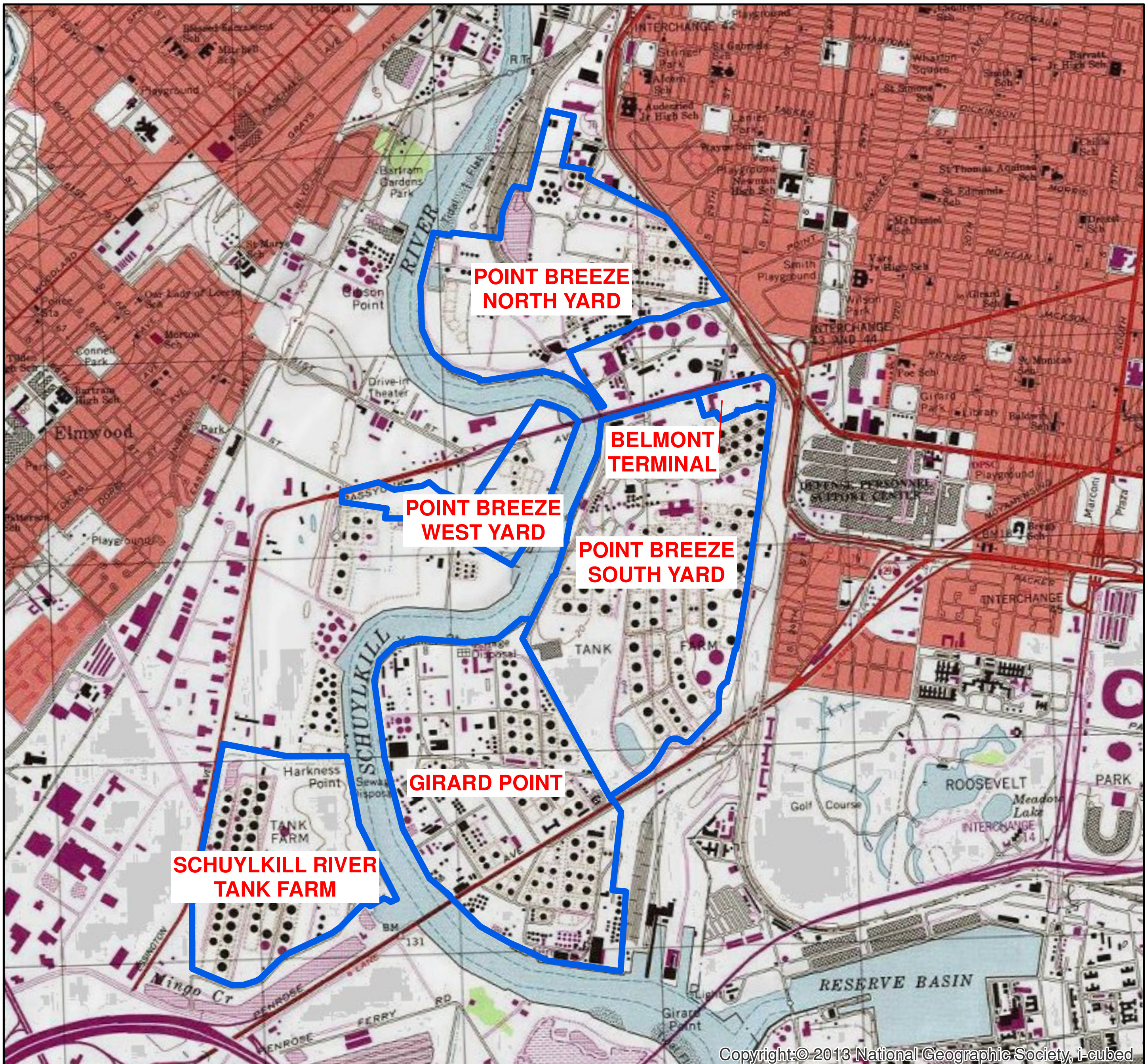
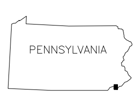



IMAGE SOURCE: DVRPC/PASDA 2010




QUADRANGLE LOCATION

0 750 1,500 3,000 4,500 Feet

N

REFERENCE: USGS 7.5 MINUTE QUADRANGLE; MARCUS HOOK, PA.-NJ.-DEL., QUADRANGLE, 1993

Stantec

**Stantec Consulting Services Inc.**
1060 Andrew Drive, Suite 140
West Chester, Pennsylvania
19380
Tel. 610-840-2500
Fax. 610-840-2501
www.stantec.com

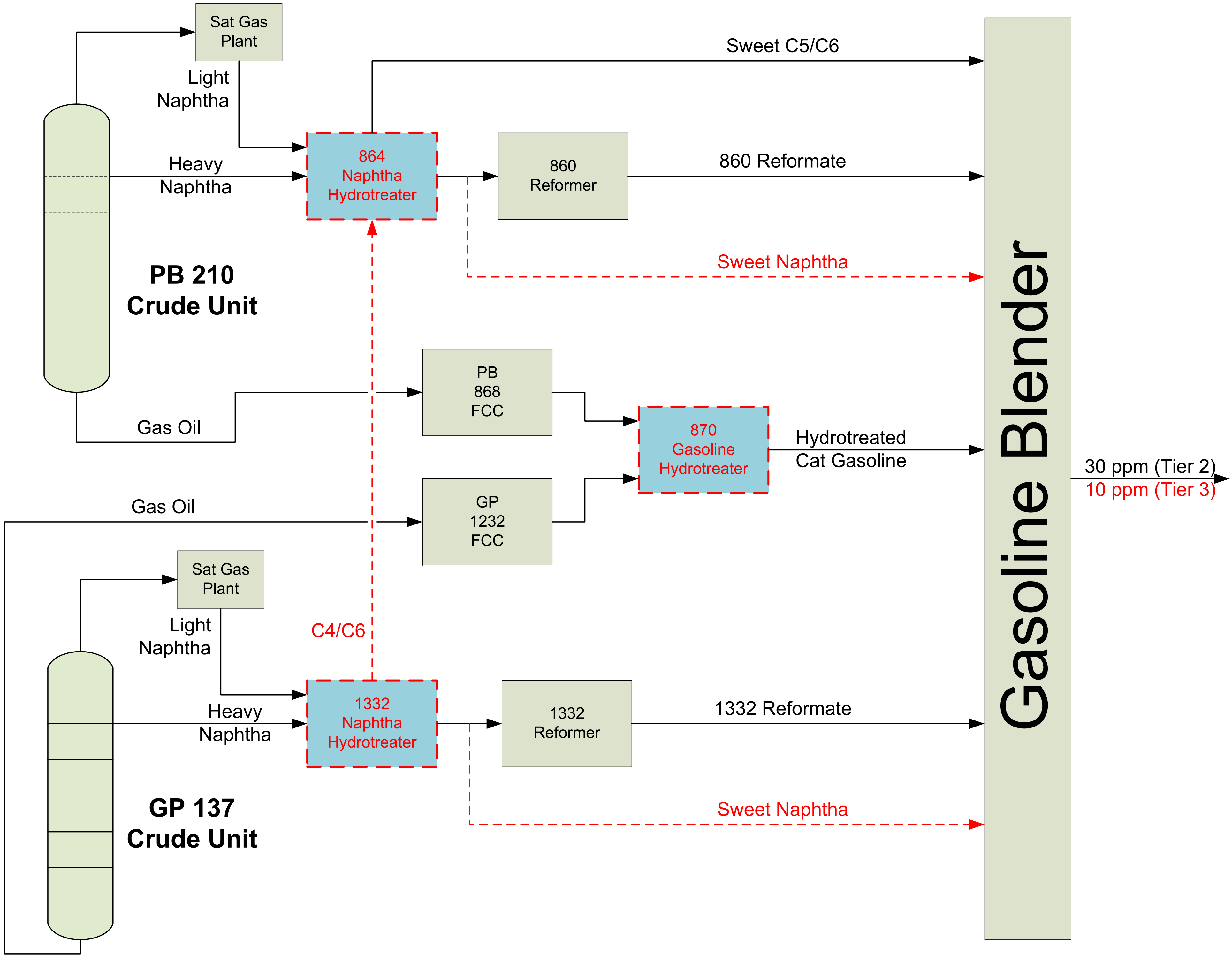
Prepared For:

PHILADELPHIA ENERGY SOLUTIONS
PHILADELPHIA REFINERY
3144 PASSYUNK AVENUE
PHILADELPHIA, PA. 19145

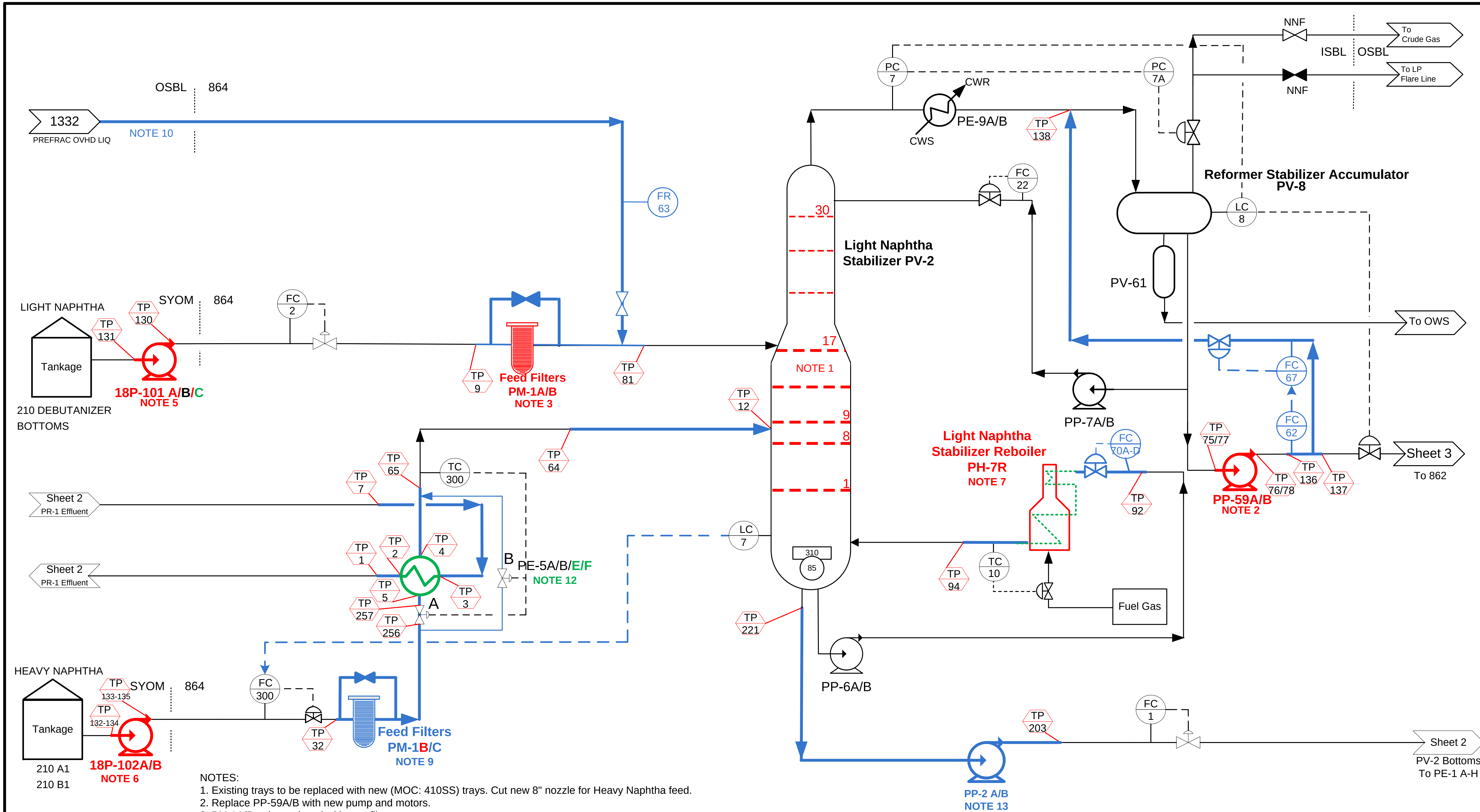
Figure Title:

SITE LOCATION MAP

DRAWN BY: TFB
CHECKED BY: JLM
APPROVED BY: JLM
DATE: 1/17/2014



Sat Gas Plant
Light Naphtha
Sweet C5/C6
864 Naphtha Hydrotreater
Heavy Naphtha
860 Reformer
860 Reformate
Sweet Naphtha
PB 210 Crude Unit
PB 868 FCC
Gas Oil
870 Gasoline Hydrotreater
Hydrotreated Cat Gasoline
Gasoline Blender
30 ppm (Tier 2)
10 ppm (Tier 3)
Gas Oil
GP 1232 FCC
Sat Gas Plant
Light Naphtha
C4/C6
1332 Naphtha Hydrotreater
Heavy Naphtha
1332 Reformer
1332 Reformate
Sweet Naphtha
GP 137 Crude Unit




NOTES:
1. Existing trays to be replaced with new (MOC: 410SS) trays. Cut new 8" nozzle for Heavy Naphtha feed.
2. Replace PP-59A/B with new pump and motors.
3. PM-1A/B to be replaced with new filters.
4. DELETED
5. SYOM 18P-101 A to be replaced with new pump and motor. 18P-101C to be modified with a larger diameter impeller.
6. SYOM 18P-102 A/B, pumps to be replaced new pumps and motors.
7. Replace PH-7 in full with existing Eagle Point 511H-1 Heater. Modify from 8 pass to 4 pass.
8. DELETED
9. Install new PM-1C feed filter on Heavy Naphtha tank feed from SYOM. New PM-1B is a common spare.
10. 1332 PREFAC OVHD OSBL liquid line cost included in project 64OZ5149.
11. DELETED
12. PE-5 A/B, reconfigure such that reactor effluent flows through the tube side and new Heavy Naphtha line flows through shell. Recondition and add piping to PE-5 E/F shells to be utilized as stand-by spare.
13. PP-2A/B, New Unifiner Charge pumps.

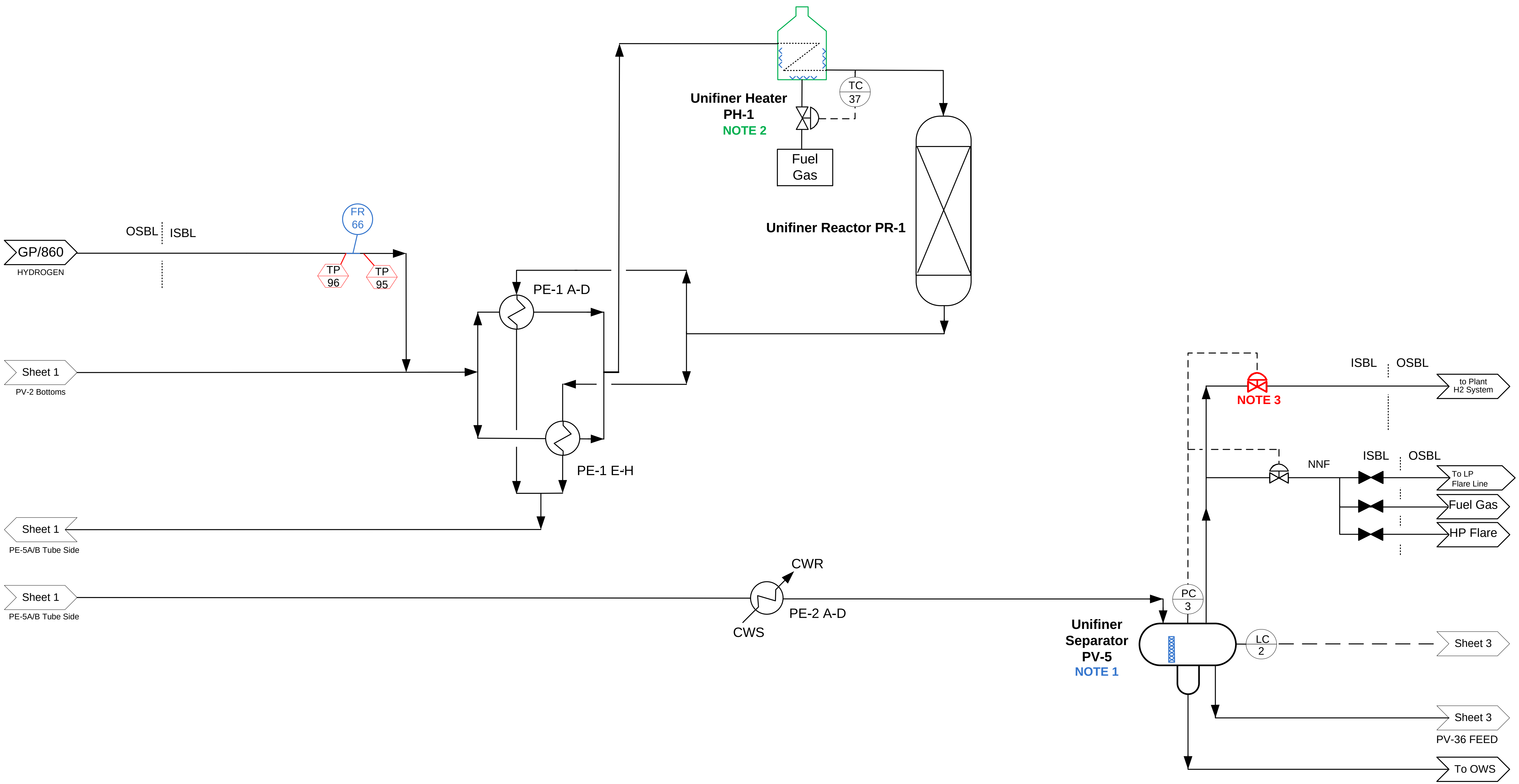
Modified Equipment
Replaced Equipment
New Equipment

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|
| A | 8/11/2015 | FOR INFORMATION ONLY | PT | DG | DG |

Philadelphia Energy Solutions

Process Flow Sketch
864 UNIFINER UNIT
864 UNIFINER RECONFIGURATION
(TIER 3 GASOLINE)

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| 64OZ5148 | 64OZ5148-1110-SK-0001 | 1 of 5 | A |




NOTES:
1. Install new coalescing pad in PV-5.
2. PH-1, install new Low NOx burners.
3. Replace PCV-5 with a new valve.

Modified Equipment
Replaced Equipment
New Equipment

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|
| A | 8/11/2015 | FOR INFORMATION ONLY | PT | DG | DG |

Philadelphia Energy Solutions

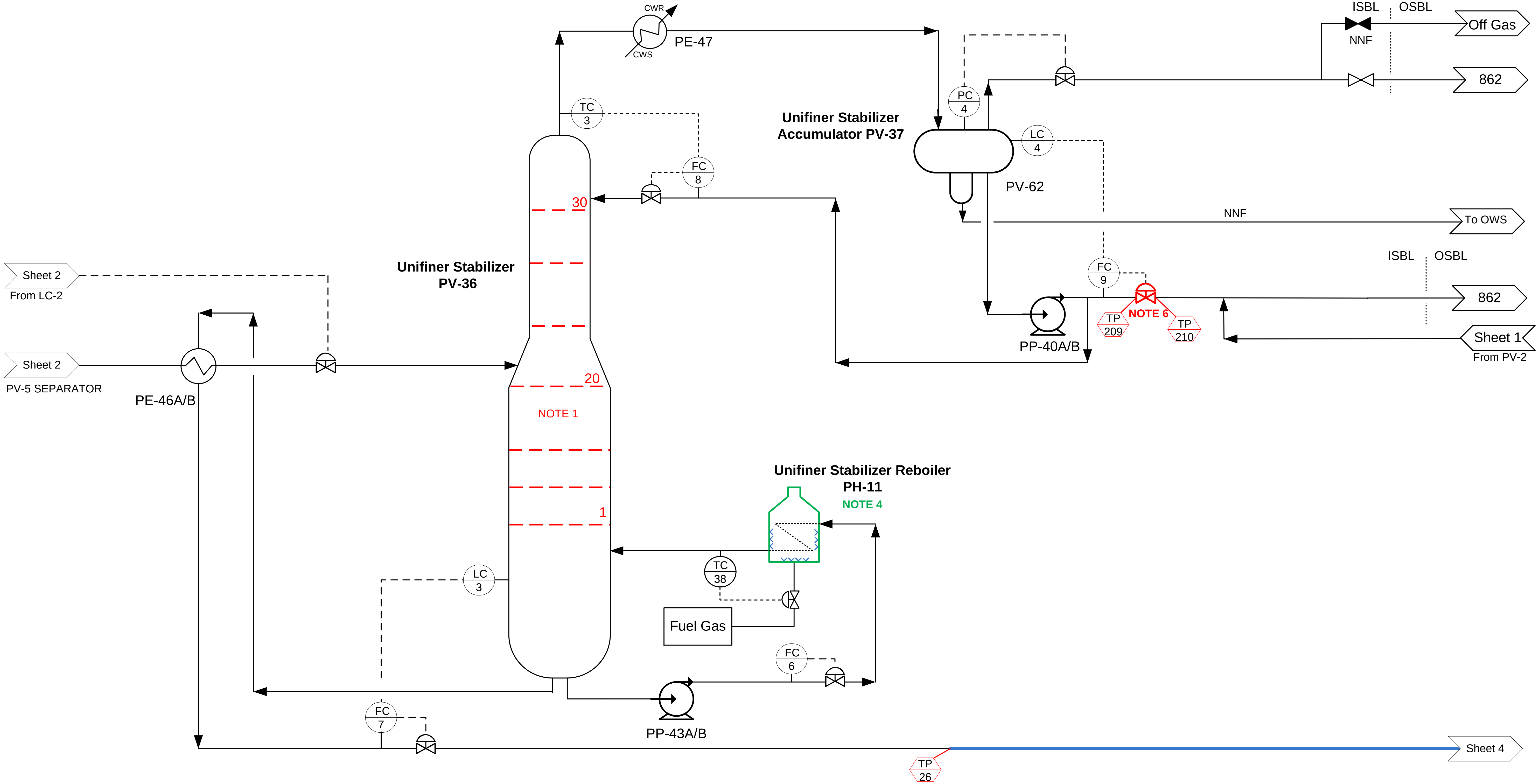
Process Flow Sketch

864 UNIFINER UNIT

864 UNIFINER RECONFIGURATION

(TIER 3 GASOLINE)

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| 64OZ5148 | 64OZ5148-1110-SK-0001 | 2 of 5 | A |




NOTES:
1. PV-36, existing trays to be replaced with new trays (MOC: 410SS).
2. DELETED
3. DELETED
4. PH-11, install new Low NOx burners.
5. DELETED
6. FCV-9 to be placed with new valve.

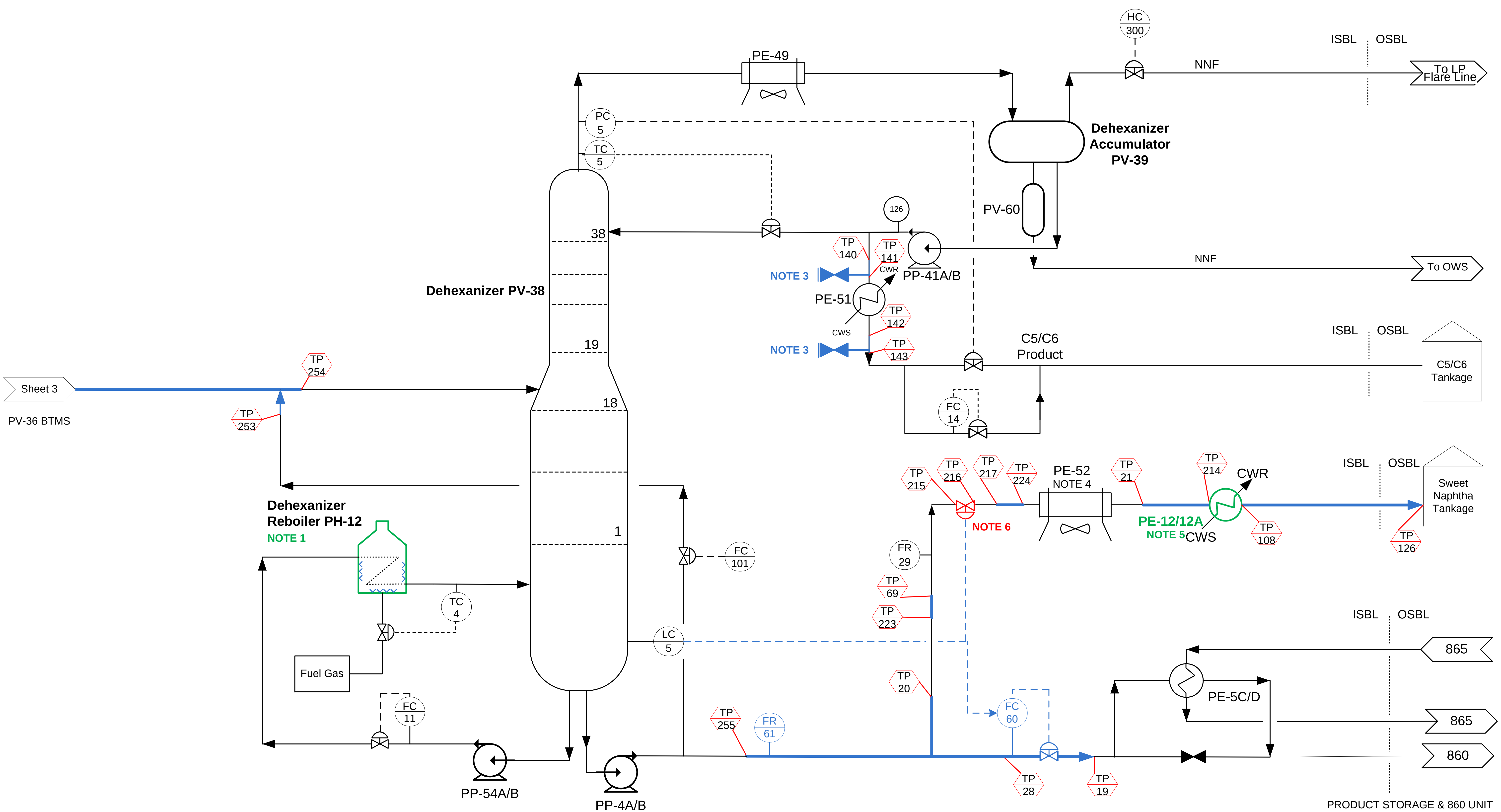
Modified Equipment
Replaced Equipment
New Equipment

Philadelphia Energy Solutions

Process Flow Sketch
864 UNIFINER UNIT
864 UNIFINER RECONFIGURATION
(TIER 3 GASOLINE)

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|
| A | 8/11/2015 | FOR INFORMATION ONLY | PT | DG | DG |

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| 64OZ5148 | 64OZ5148-1110-SK-0001 | 3 of 5 | A |




NOTES:
1. PH-12, install new Low NOx burners.
2. DELETED
3. Connections for future additional cooling.
4. PE-52, Change service from PV-2 bottoms cooling to PV-38 bottoms cooling. Some piping modifications required.
5. PE-12/12A to be returned to service and used as sweet naphtha product cooler to tankage.
6. FV-29, to be replaced with new valve. Control mode changed from flow to level.
FRC-29 to be used for indication only.

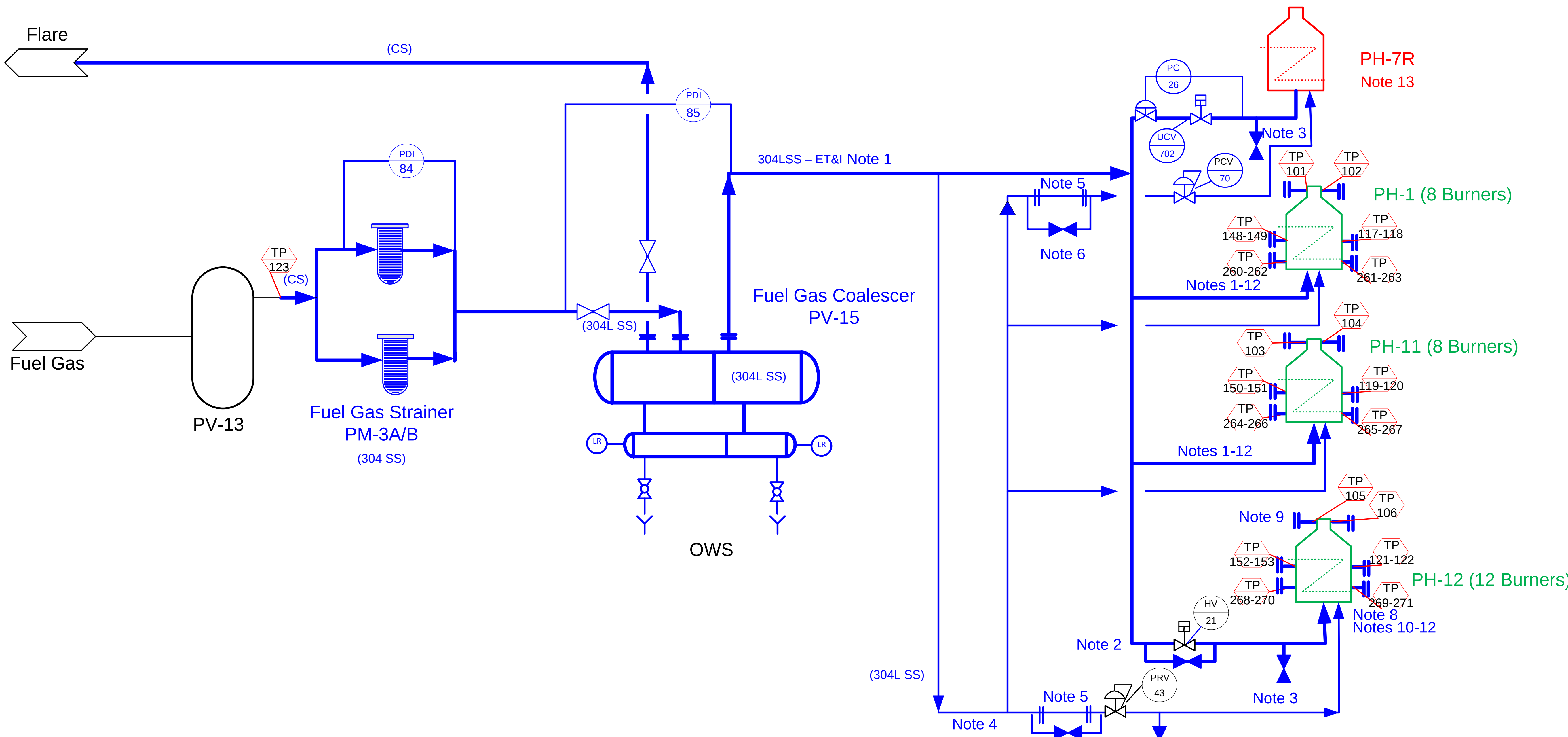
Modified Equipment
Replaced Equipment
New Equipment

Philadelphia Energy Solutions

Process Flow Sketch
864 UNIFINER UNIT
864 UNIFINER RECONFIGURATION
(TIER 3 GASOLINE)

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|
| A | 8/11/2015 | FOR INFORMATION ONLY | PT | DG | DG |

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| 64OZ5148 | 64OZ5148-1110-SK-0001 | 4 of 5 | A |



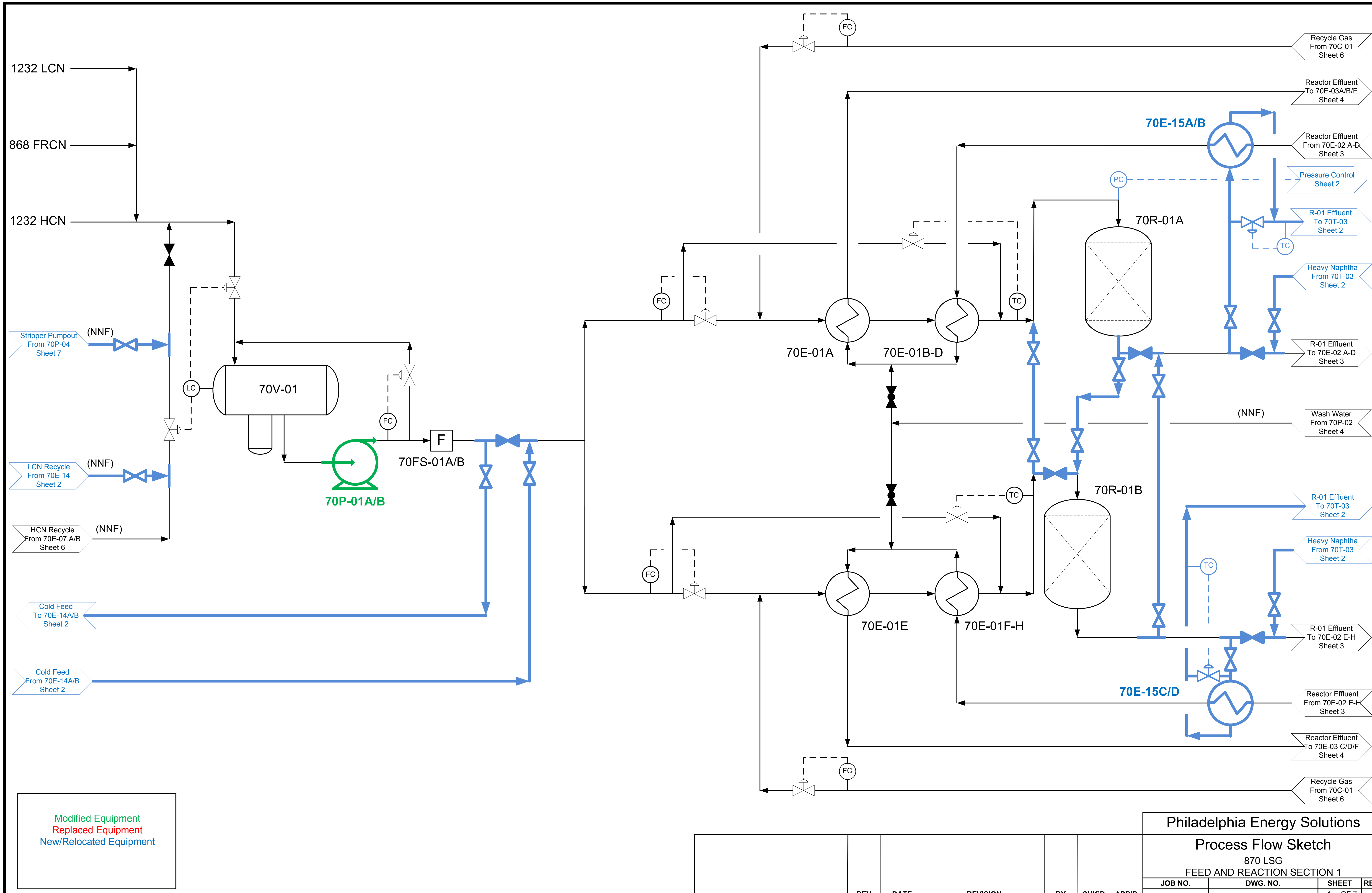

NOTES:
1. All existing fuel gas piping and valves downstream of the coalescer to be replaced with 304 SS with the exception of control valve and ROEIV.
2. Add bypass around existing ROEIV.
3. Add three 1" connections downstream of each fuel gas control valve for future pressure transmitters.
4. New pilot piping to be all 304L SS including valves with the exception of existing pilot gas pressure regulators.
5. Add a removable spool upstream of the pilot gas pressure regulator for an ROEIV at a later date.
6. Add a bypass around the removable spool in Note 5.
7. Add a 1" connection downstream of the pilot gas pressure regulator.
8. Add two sets of new 3" 150# flange at the top of each radiant section (two per set) for future Oxygen and combustibles analyzer.
9. Install two 3" flanges, 90° apart, on each stack above the damper for stack testing.
10. Replace gaskets on heater doors as needed.
11. Replace heater tube seals as needed.
12. New heater sight ports to be installed at all existing sight doors ( 4 doors)
13. Fired heater formerly 511H-1 from EP replaces PH-7

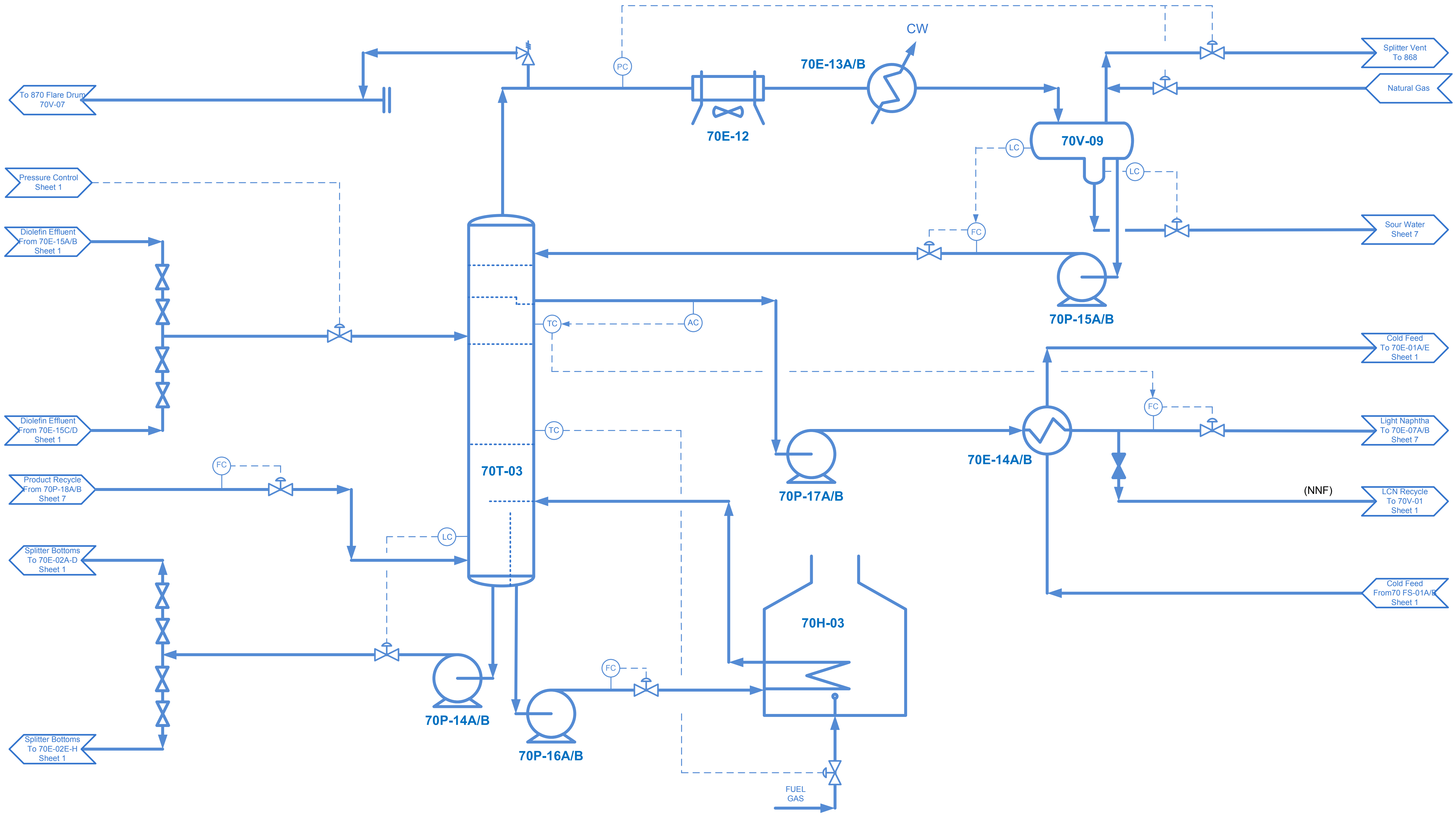
Modified Equipment
Replaced Equipment
New Equipment
Std. Flow, MBPD
, MSCFH
Temperature, F
Pressure, PSIG

Philadelphia Energy Solutions

Process Flow Sketch
864 UNIFINER UNIT
864 UNIFINER RECONFIGURATION (TIER 3)
Fired Heaters, FG Coalescer and NG Pilots

| REV | DATE | REVISION | BY | CHK'D | APR'D | JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|---|---|---|---|---|---|
| A | 8/11/2015 | FOR INFORMATION ONLY | PT | DG | DG | 64OZ5148 | 64OZ5148-1110-SK-0001 | 5 of 5 | A |


1232 LCN
868 FRCN
1232 HCN
Stripper Pumpout From 70P-04 Sheet 7
(NNF)
LCN Recycle From 70E-14 Sheet 2
(NNF)
HCN Recycle From 70E-07 A/B Sheet 6
(NNF)
Cold Feed To 70E-14A/B Sheet 2
Cold Feed From 70E-14A/B Sheet 2
LC
70V-01
FC
F
70FS-01A/B
70P-01A/B
FC
FC
FC
FC
TC
TC
70E-01A
70E-01B-D
70E-01E
70E-01F-H
70R-01A
70R-01B
70E-15A/B
70E-15C/D
PC
TC
TC
Recycle Gas From 70C-01 Sheet 6
Reactor Effluent To 70E-03A/B/E Sheet 4
Reactor Effluent From 70E-02 A-D Sheet 3
Pressure Control Sheet 2
R-01 Effluent To 70T-03 Sheet 2
Heavy Naphtha From 70T-03 Sheet 2
R-01 Effluent To 70E-02 A-D Sheet 3
(NNF)
Wash Water From 70P-02 Sheet 4
R-01 Effluent To 70T-03 Sheet 2
Heavy Naphtha From 70T-03 Sheet 2
R-01 Effluent To 70E-02 E-H Sheet 3
Reactor Effluent From 70E-02 E-H Sheet 3
Reactor Effluent To 70E-03 C/D/F Sheet 4
Recycle Gas From 70C-01 Sheet 6
Modified Equipment
Replaced Equipment
New/Relocated Equipment
Philadelphia Energy Solutions
Process Flow Sketch
870 LSG
FEED AND REACTION SECTION 1
REV
DATE
REVISION
BY
CHK'D
APR'D
JOB NO.
DWG. NO.
SHEET
REV.
1 OF 7




Modified Equipment
Replaced Equipment
New/Relocated Equipment

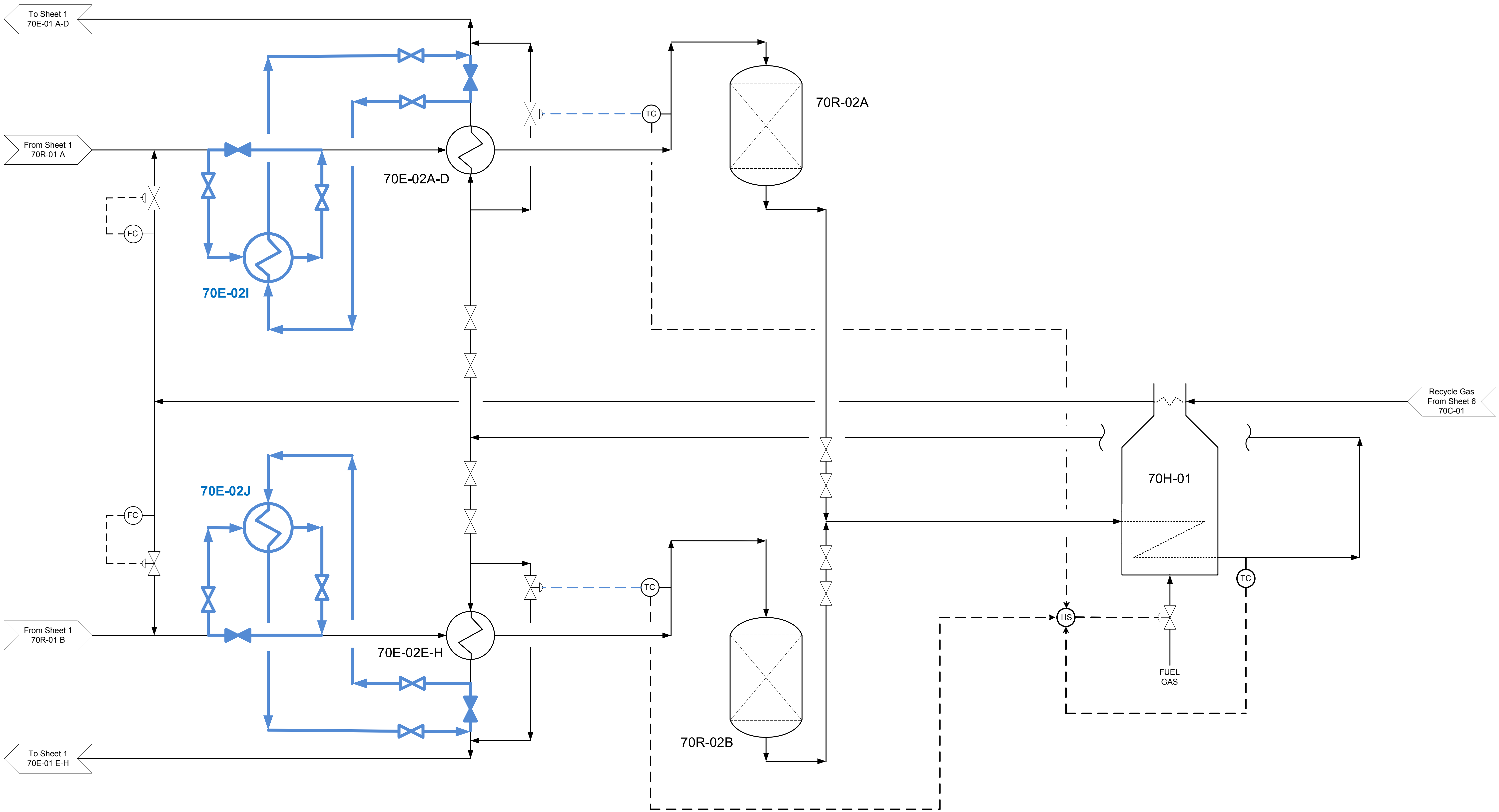
| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|

Philadelphia Energy Solutions

Process Flow Sketch

870 LSG

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| | | 2 OF 7 | |




Modified Equipment
Replaced Equipment
New/Relocated Equipment

Philadelphia Energy Solutions

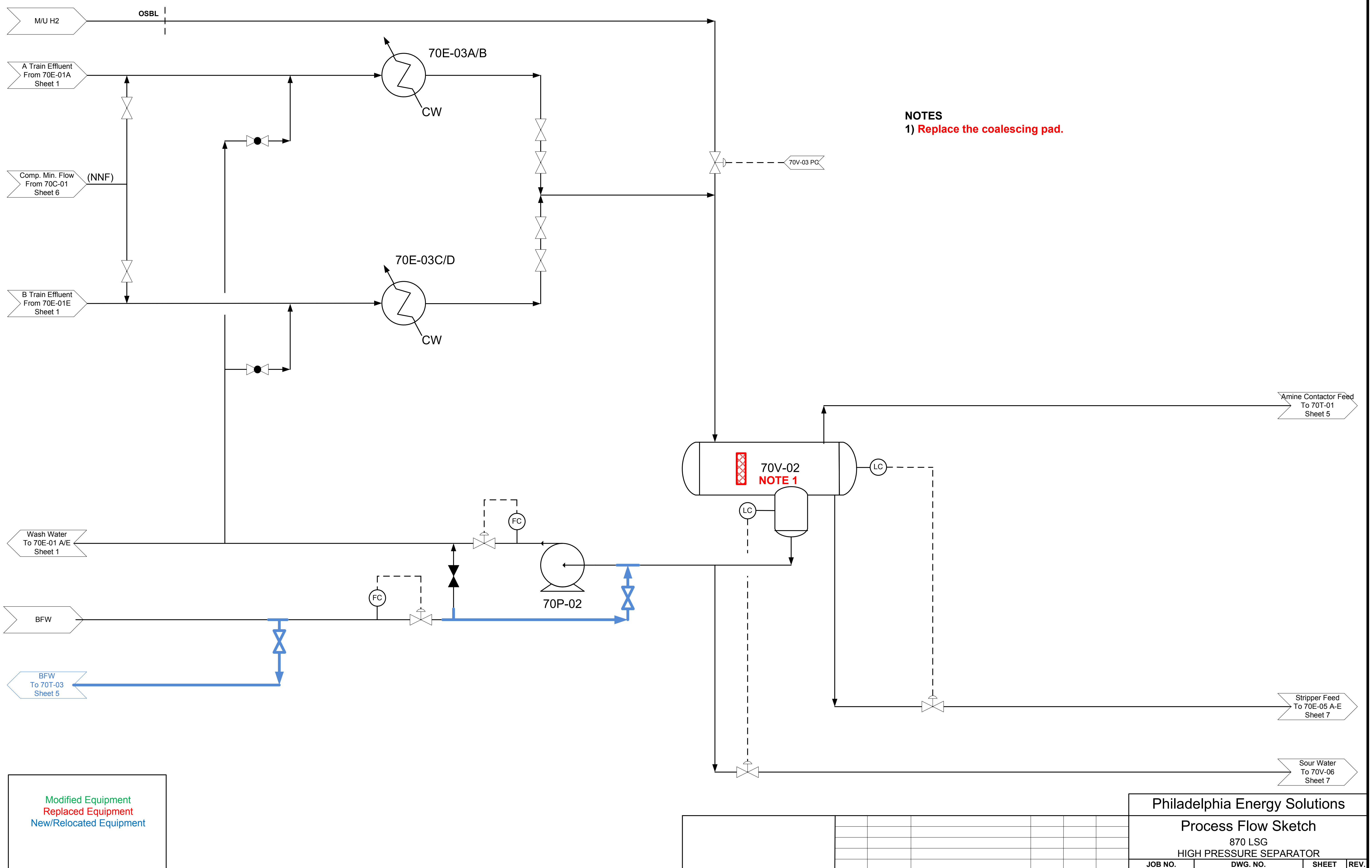
Process Flow Sketch

870 LSG

REACTION SECTION 2

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| | | 3 OF 7 | |




**NOTES**

1) Replace the coalescing pad.

Philadelphia Energy Solutions

Process Flow Sketch

870 LSG

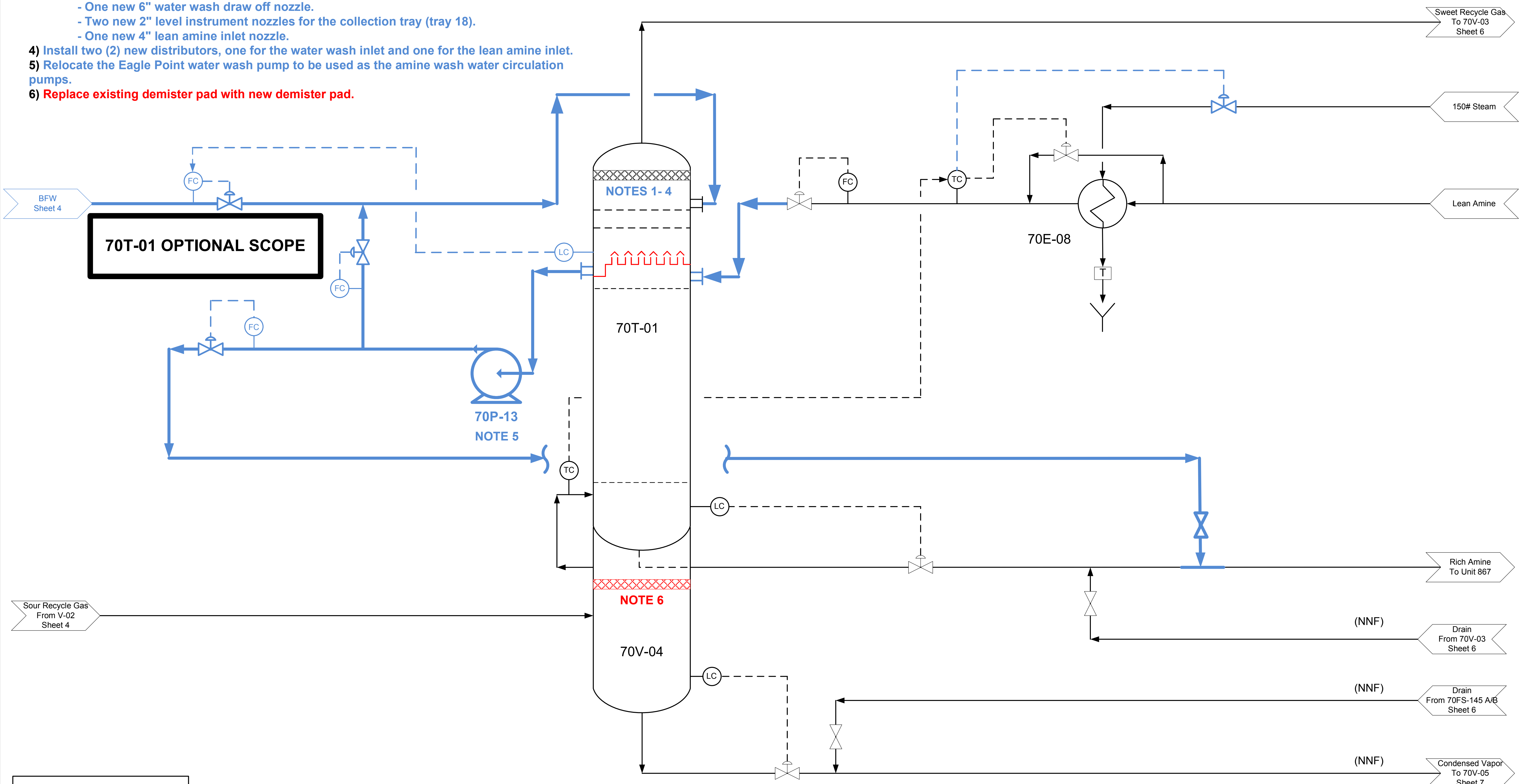
HIGH PRESSURE SEPARATOR

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| | | 4 OF 7 | |

**NOTES**

1) Repurpose the top three trays (trays 18-20) of the Amine Absorber as a water wash section.
2) Remove tray 18 and install a new chimney tray to act as a collection tray for the new wash water section of the column.
3) Cut four (4) new nozzles.
- One new 6" water wash draw off nozzle.
- Two new 2" level instrument nozzles for the collection tray (tray 18).
- One new 4" lean amine inlet nozzle.
4) Install two (2) new distributors, one for the water wash inlet and one for the lean amine inlet.
5) Relocate the Eagle Point water wash pump to be used as the amine wash water circulation pumps.
6) Replace existing demister pad with new demister pad.




Modified Equipment
Replaced Equipment
New/Relocated Equipment

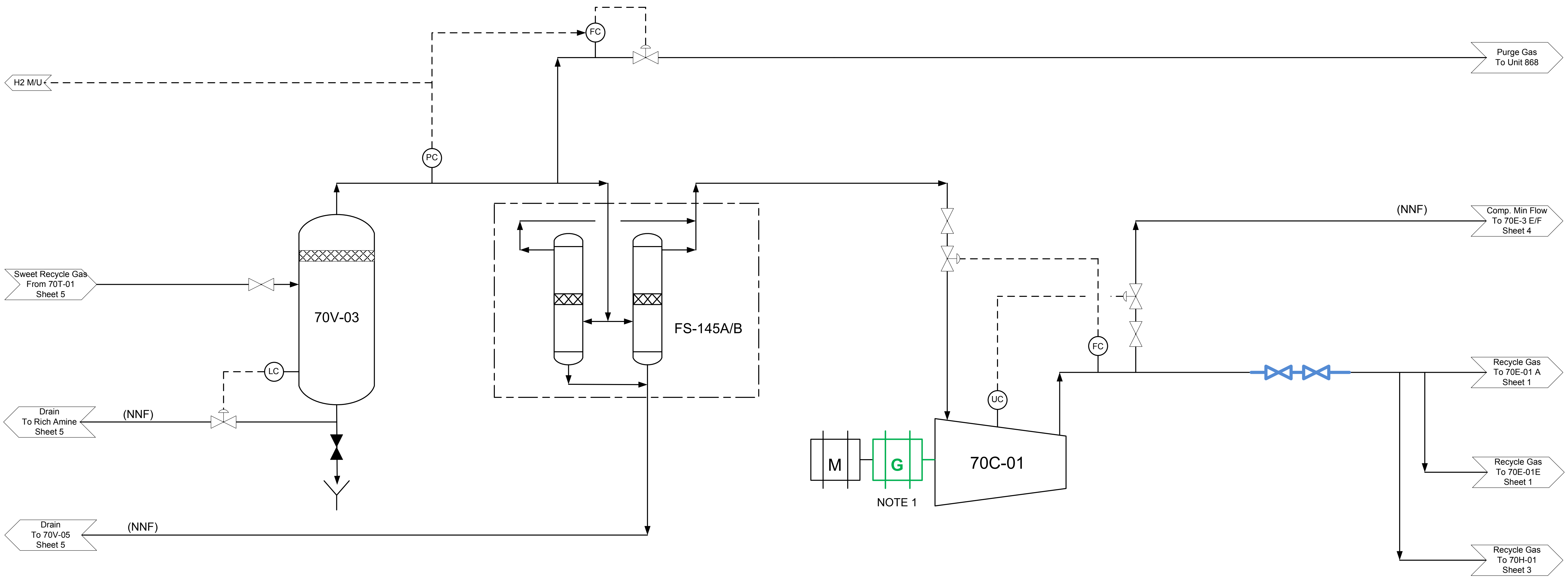
Philadelphia Energy Solutions

Process Flow Sketch

870 LSG
AMINE TREATING

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| | | 5 OF 7 | |




**NOTES**

**1) Modify the existing 70C-01 gear set to reduce compressor speed.**

Modified Equipment
Replaced Equipment
New/Relocated Equipment

Philadelphia Energy Solutions

Process Flow Sketch

870 LSG

RECYCLE GAS COMPRESSOR

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|

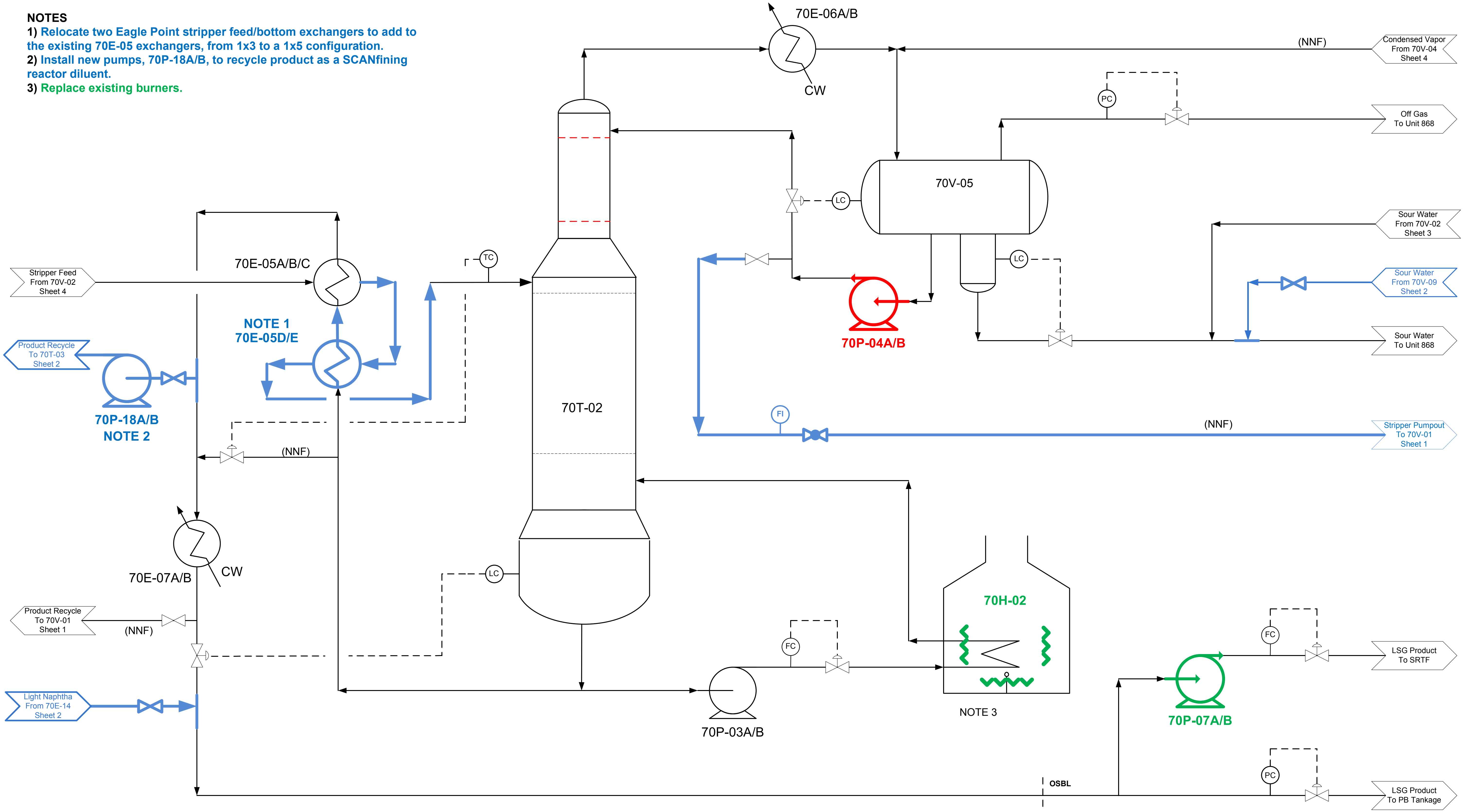
| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| | | 6 OF 7 | |

**NOTES**

1) Relocate two Eagle Point stripper feed/bottom exchangers to add to the existing 70E-05 exchangers, from 1x3 to a 1x5 configuration.

2) Install new pumps, 70P-18A/B, to recycle product as a SCANfining reactor diluent.

3) Replace existing burners.




Modified Equipment
Replaced Equipment
New/Relocated Equipment

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|

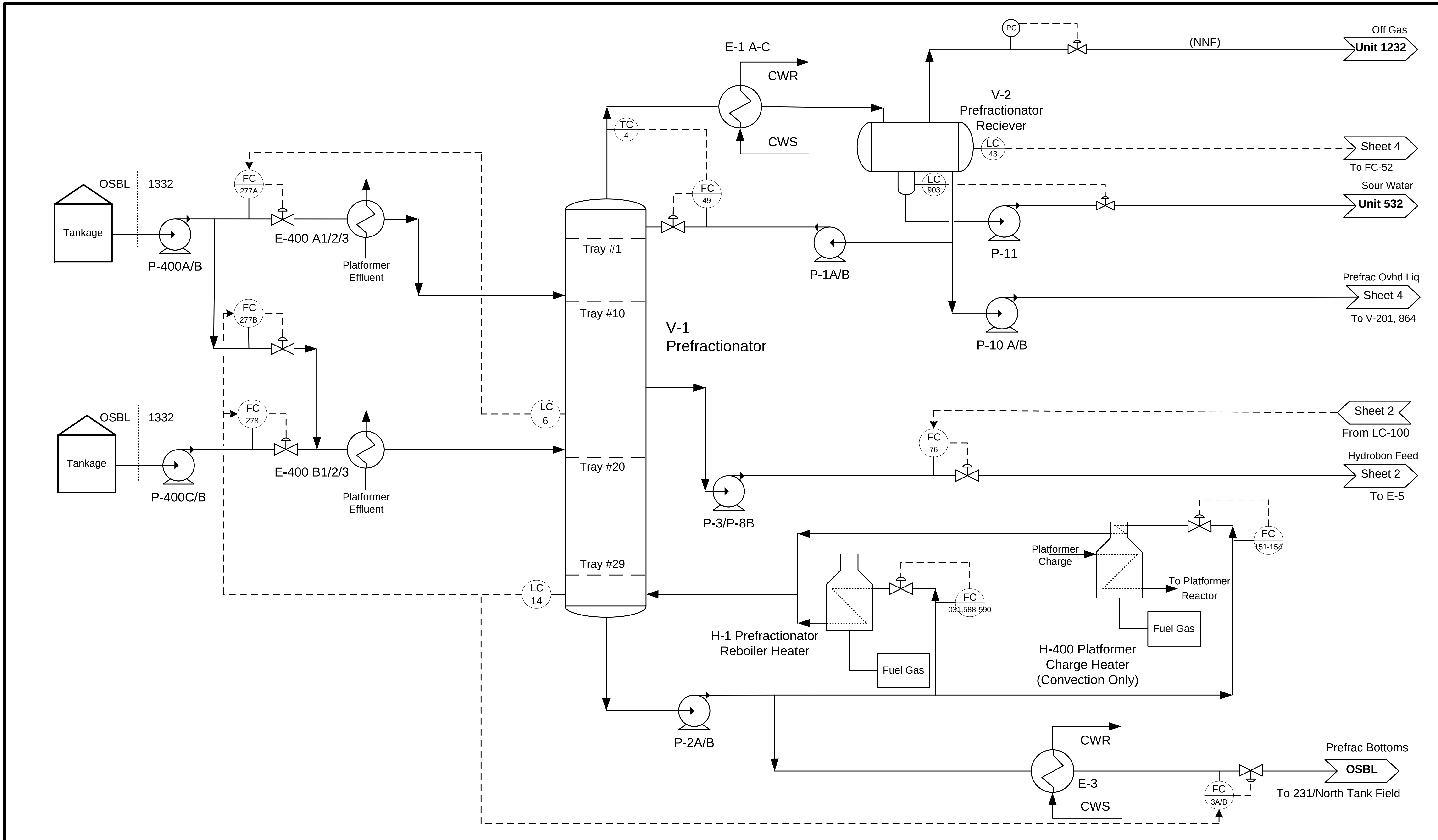
Philadelphia Energy Solutions

Process Flow Sketch

870 LSG

PRODUCT STRIPPER

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| | | 7 OF 7 | |




Modified Equipment
Replaced Equipment
New Equipment

Philadelphia Energy Solutions

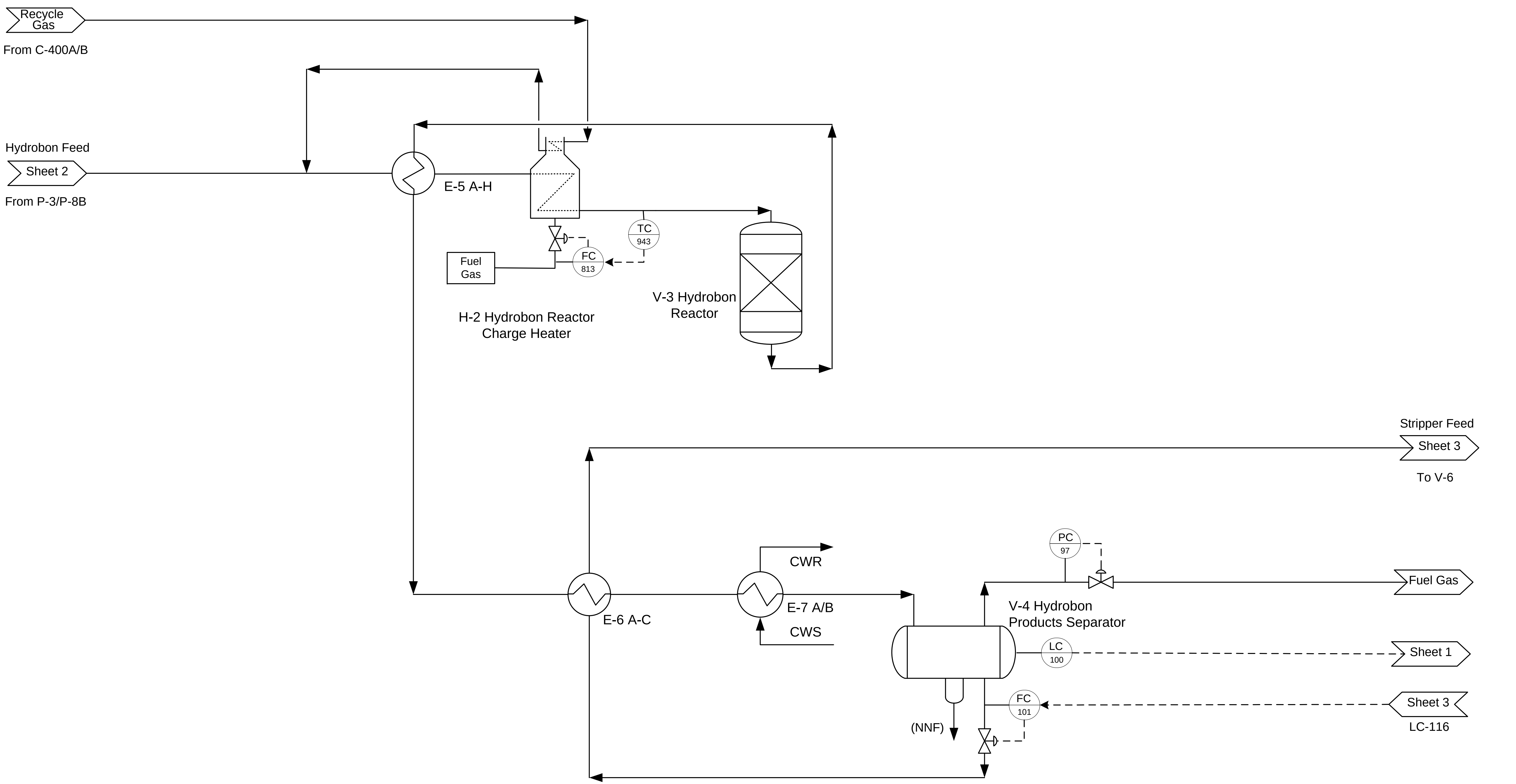
Process Flow Sketch

Tier 3 Gasoline Compliance

Modifications to 1332 Hydrobon Unit at Girard Point

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|
| A | 8/11/15 | FOR INFORMATION ONLY | PT | DG | DG |

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| 64OZ5149 | 64OZ5149-1110-SK-0001 | 1 of 4 | A |




Modified Equipment
Replaced Equipment
New Equipment

Philadelphia Energy Solutions

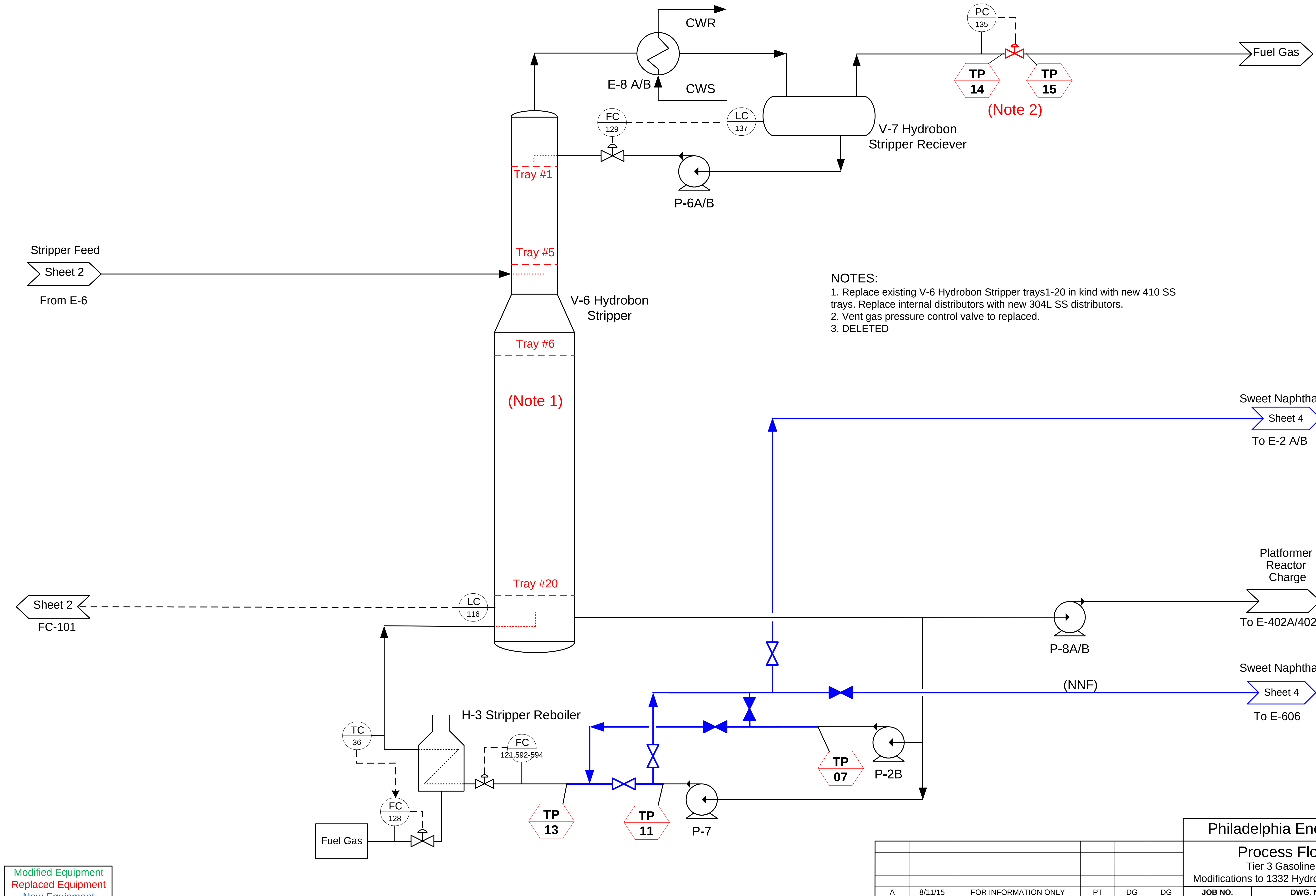
Process Flow Sketch

Tier 3 Gasoline Compliance

Modifications to 1332 Hydrobon Unit at Girard Point

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|
| A | 8/11/15 | FOR INFORMATION ONLY | PT | DG | DG |

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| 64OZ5149 | 64OZ5149-1110-SK-0001 | 2 of 4 | A |



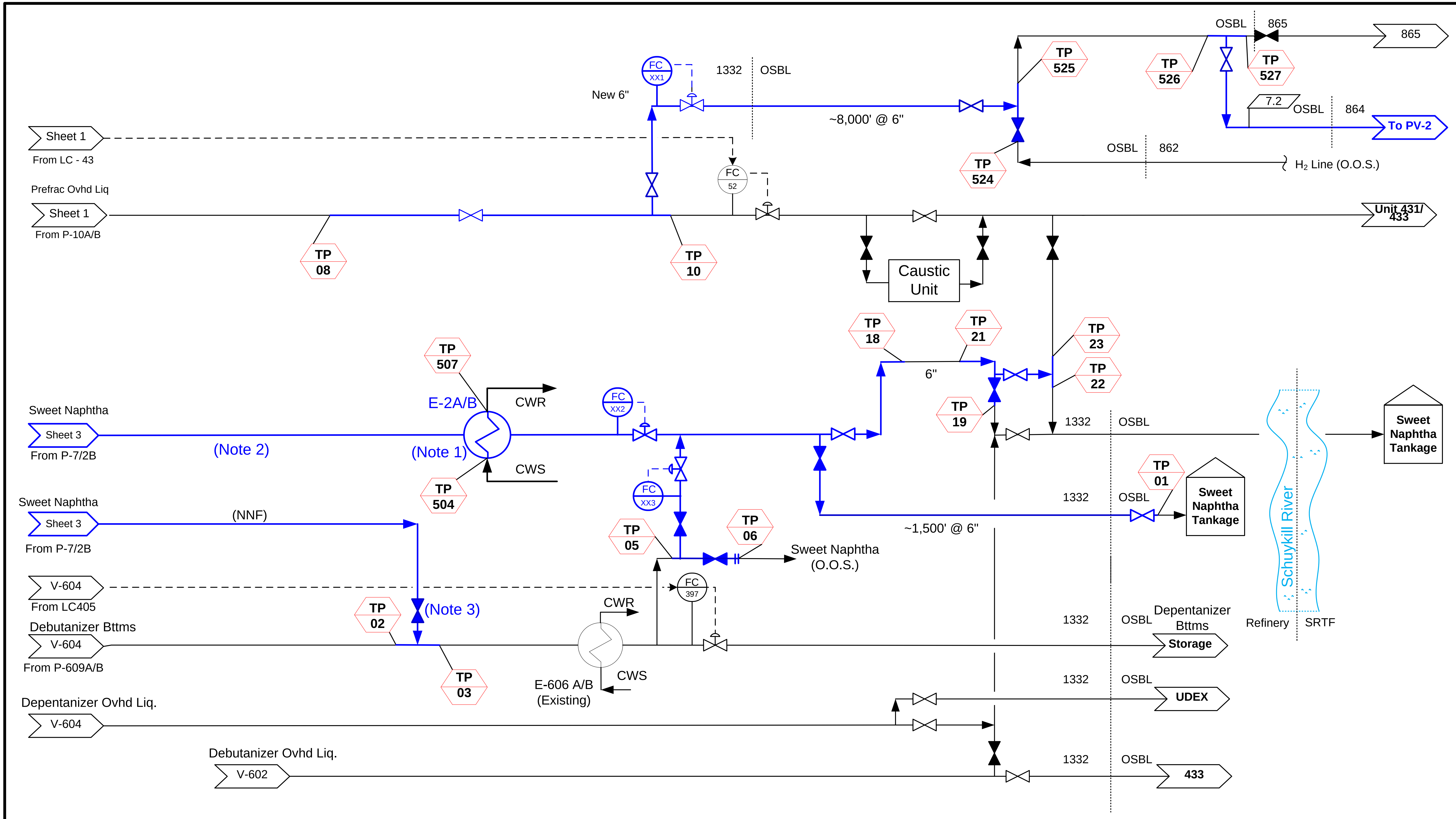

NOTES:
1. Replace existing V-6 Hydrobon Stripper trays1-20 in kind with new 410 SS trays. Replace internal distributors with new 304L SS distributors.
2. Vent gas pressure control valve to replaced.
3. DELETED

| | | | | | |
|---|---|---|---|---|---|
| A | 8/11/15 | FOR INFORMATION ONLY | PT | DG | DG |
| REV | DATE | REVISION | BY | CHK'D | APR'D |

Philadelphia Energy Solutions

Process Flow Sketch
Tier 3 Gasoline Compliance
Modifications to 1332 Hydrobon Unit at Girard Point

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| 64OZ5149 | 64OZ5149-1110-SK-0001 | 3 of 4 | A |




NOTES:
1. Existing E-2 (OOS) cooler to be replaced with a new exchangers.
2. Normal Case Sweet Naphtha flow to E-2 A/B.
3. When Platformer is down Sweet Naphtha flows to E-606 A/B.

Modified Equipment
Replaced Equipment
New Equipment

Philadelphia Energy Solutions

Process Flow Sketch
Tier 3 Gasoline Compliance
Modifications to 1332 Hydrobon Unit at Girard Point

| REV | DATE | REVISION | BY | CHK'D | APR'D |
|---|---|---|---|---|---|
| A | 8/11/15 | FOR INFORMATION ONLY | PT | DG | DG |

| JOB NO. | DWG. NO. | SHEET | REV. |
|---|---|---|---|
| 64OZ5149 | 64OZ5149-1110-SK-0001 | 4 of 4 | A |

*Attachment C*
*Back-up Emissions Calculations*

**PES Refinery**
**Tier 3 Project Emissions**
**April 2016**

**<u>Emissions Summary</u>**

| Source | $NO_2$ | $NO_x$ | $SO_2$ | CO | PM | $PM_{10}$ | $PM_{2.5}$ | VOC | Lead | $CO_2e$ |
|---|---|---|---|---|---|---|---|---|---|---|
| Fired Heaters | 34.6 | 11.2 | 4.4 | 66.4 | 11.9 | 11.9 | 6.7 | 6.5 | 8.3E-04 | 200,084 |
| *864 PH-1* | *- - -* | *-2.6* | *0.5* | *15.9* | *1.4* | *1.4* | *1.4* | *1.0* | *9.4E-05* | *22,758* |
| *864 PH-7* | *- - -* | *-10.2* | *- - -* | *- - -* | *- - -* | *- - -* | *- - -* | *-0.7* | *- - -* | *- - -* |
| *864 PH-11* | *- - -* | *-6.2* | *0.4* | *12.0* | *1.1* | *1.1* | *1.1* | *0.8* | *7.1E-05* | *17,213* |
| *864 PH-12* | *- - -* | *-4.4* | *0.4* | *12.1* | *1.1* | *1.1* | *1.1* | *0.8* | *7.2E-05* | *17,341* |
| ***864 PH-13*** | ***6.5*** | ***6.5*** | ***0.9*** | ***9.7*** | ***2.3*** | ***2.3*** | ***0.7*** | ***1.6*** | ***1.5E-04*** | ***35,902*** |
| *870 H-1* | *7.8* | *7.8* | *0.6* | *0.4* | *1.7* | *1.7* | *0.6* | *0.1* | *1.3E-04* | *31,413* |
| *870 H-2* | *2.6* | *2.6* | *0.3* | *0.0* | *0.2* | *0.2* | *0.2* | *0.1* | *4.5E-05* | *10,943* |
| ***870 H-3*** | ***14.5*** | ***14.5*** | ***1.1*** | ***14.5*** | ***3.6*** | ***3.6*** | ***1.1*** | ***2.4*** | ***2.3E-04*** | ***56,417*** |
| *1332 H-2* | *1.6* | *1.6* | *0.2* | *0.5* | *0.4* | *0.4* | *0.4* | *0.3* | *2.4E-05* | *6,079* |
| *1332 H-3* | *1.6* | *1.6* | *0.1* | *1.4* | *0.1* | *0.1* | *0.1* | *0.1* | *8.1E-06* | *2,018* |
| Incremental Cooling Water | - | - | - | - | 0.2 | 0.1 | 0.001 | 0.1 | - | - |
| Incremental Sulfur Production | 0.08 | 0.08 | 0.2 | 3.3 | - | - | - | - | - | - |
| Fugitive Components | - | - | - | - | - | - | - | 0.01 | - | - |
| **Total Emissions (TPY)** | **34.6** | **11.2** | **4.7** | **69.7** | **12.0** | **12.0** | **6.7** | **6.7** | **8.3E-04** | **200,084** |

**PES Refinery**
**Tier 3 Project Emissions**
**April 2016**

**PSD and NANSR Analysis**

| Parameter | Total Emissions (TPY) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | $NO_2$ | $NO_x$ | $SO_2$ | CO | PM | $PM_{10}$ | $PM_{2.5}$ | $H_2SO_4$ | Lead | VOC | $CO_2e$ |
| PES Tier 3 Project | 34.6 | 11.2 | 4.7 | 69.7 | 12.0 | 12.0 | 6.7 | 0 | 8.3E-04 | 6.7 | 200,084 |

| PSD Emissions Analysis (Step 1) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Parameter | Pollutant (TPY) | | | | | | | | |
| | $NO_2$ | $SO_2$ | CO | PM | $PM_{10}$ | $PM_{2.5}$ | $H_2SO_4$ | Lead | $CO_2e$ |
| PES Tier 3 Project | 34.6 | 4.7 | 69.7 | 12.0 | 12.0 | 6.7 | 0 | 8.3E-04 | 200,084 |
| PSD Significant Level | 40 | 40 | 100 | 25 | 15 | 10 | 7 | 0.6 | 75,000 |
| PSD Triggered (Before Netting Analysis) | No | No | No | No | No | No | No | No | No |

| Parameter | 5 calendar year $NO_x$ (TPY) | 5 calendar year VOC (TPY) |
|---|---|---|
| PES Tier 3 Project | 11.2 | 6.7 |
| Contemporaneous Increases | 12.8 | 8.6 |
| **Net Emissions Increase** | **24.1** | **15.3** |
| NANSR Significance Level | 25 | 25 |
| **NANSR Review Required** | **No** | **No** |

| Parameter | 10 year $NO_x$ (TPY) | 10 year VOC (TPY) |
|---|---|---|
| PES Tier 3 Project | 11.2 | 6.7 |
| Contemporaneous Increases/Decreases | 23.4 | 23.8 |
| **Net Emissions Increase** | **34.6** | **30.5** |
| NANSR Significance Level | 25 | 25 |
| **NANSR Review Required** | **Yes** | **Yes** |

**PES Refinery**
**Tier 3 Project Emissions**
**April 2016**

**Fired Heater Emissions**

| Unit | Fired Heater | Annual Average Expected Firing Rate (MMBtu/hr) |
|---|---|---|
| 864 | PH-1 | 74.9 |
| 864 | PH-11 | 74 |
| 864 | PH-12 | 85.1 |
| 864 | PH-13 (former Eagle Point) | 70 |
| 870 | H-1 | 97 |
| 870 | H-2 | 53 |
| 870 | H-3 | 110 |
| 1332 | H-2 | 43.8 |
| 1332 | H-3 | 28.1 |

| Month | 864 (MMBtu/month) | | | | 870 (MMBtu/month) | | | 1332 (MMBtu/ month) | |
|---|---|---|---|---|---|---|---|---|---|
| | PH-1 | PH-11 | PH-12 | PH-13 | H-1 | H-2 | H-3 | H-2 | H-3 |
| Jun-12 | 21,142 | 27,619 | 28,387 | - - - | 32,448 | 26,447 | - - - | 24,763 | 17,521 |
| Jul-12 | 19,163 | 23,954 | 29,359 | - - - | 23,826 | 19,764 | - - - | 24,618 | 17,370 |
| Aug-12 | 18,625 | 25,904 | 28,076 | - - - | 35,139 | 28,531 | - - - | 21,647 | 17,323 |
| Sep-12 | 19,696 | 27,480 | 34,568 | - - - | 24,574 | 21,749 | - - - | 27,716 | 18,404 |
| Oct-12 | 21,115 | 28,627 | 38,607 | - - - | 29,090 | 22,822 | - - - | 27,070 | 18,278 |
| Nov-12 | 22,585 | 30,343 | 41,092 | - - - | 35,113 | 24,421 | - - - | 26,126 | 17,370 |
| Dec-12 | 20,825 | 28,281 | 40,118 | - - - | 36,165 | 27,110 | - - - | 25,102 | 17,861 |
| Jan-13 | 21,607 | 30,179 | 41,571 | - - - | 36,753 | 26,428 | - - - | 13,064 | 9,771 |
| Feb-13 | 20,012 | 28,760 | 37,840 | - - - | 16,174 | 10,775 | - - - | 0 | 0 |
| Mar-13 | 22,542 | 32,702 | 40,941 | - - - | 18,803 | 20,568 | - - - | 15,221 | 12,003 |
| Apr-13 | 22,672 | 31,092 | 38,163 | - - - | 21,564 | 26,302 | - - - | 28,797 | 20,659 |
| May-13 | 23,866 | 33,797 | 38,354 | - - - | 28,667 | 26,457 | - - - | 26,574 | 19,694 |
| Jun-13 | 21,004 | 28,705 | 36,446 | - - - | 23,811 | 26,313 | - - - | 25,199 | 18,715 |
| Jul-13 | 24,145 | 31,918 | 39,475 | - - - | 18,485 | 19,887 | - - - | 26,119 | 18,432 |
| Aug-13 | 24,032 | 31,905 | 39,726 | - - - | 26,289 | 29,603 | - - - | 26,063 | 19,753 |
| Sep-13 | 20,836 | 30,118 | 33,383 | - - - | 25,644 | 25,230 | - - - | 25,502 | 18,974 |
| Oct-13 | 22,776 | 32,317 | 38,069 | - - - | 24,432 | 23,324 | - - - | 24,239 | 20,547 |
| Nov-13 | 20,979 | 30,154 | 38,447 | - - - | 28,360 | 22,924 | - - - | 26,415 | 21,797 |
| Dec-13 | 24,731 | 30,679 | 45,798 | - - - | 27,155 | 20,371 | - - - | 24,422 | 21,594 |
| Jan-14 | 24,388 | 30,029 | 42,666 | - - - | 24,007 | 21,724 | - - - | 20,203 | 18,889 |
| Feb-14 | 22,235 | 26,445 | 41,447 | - - - | 20,598 | 18,071 | - - - | 14,957 | 14,716 |
| Mar-14 | 24,937 | 32,081 | 45,672 | - - - | 21,038 | 17,929 | - - - | 23,728 | 22,013 |
| Apr-14 | 26,464 | 30,784 | 39,587 | - - - | 25,487 | 23,007 | - - - | 29,098 | 20,760 |
| May-14 | 24,467 | 24,606 | 20,810 | - - - | 22,745 | 24,998 | - - - | 32,199 | 20,153 |
| June 12 - May 14 Average (MMBtu/hr) | 30.5 | 40.4 | 51.3 | 0.0 | 35.8 | 31.7 | 0.0 | 31.9 | 24.1 |
| 2014 Average HHV (Btu/scf) | 1,028 | 1,028 | 1,028 | 1,028 | 1,028 | 1,028 | 1,028 | 1,066 | 1,066 |

**PES Refinery**
**Tier 3 Project Emissions**
**April 2016**

**Fired Heater Emissions**

| Baseline Emission Factor (lb/MMBtu) | 864 | | | | 870 | | | 1332 | |
|---|---|---|---|---|---|---|---|---|---|
| | PH-1 | PH-11 | PH-12 | PH-13 | H-1 | H-2 | H-3 | H-2 | H-3 |
| $NO_x$ | 0.167 | 0.145 | 0.119 | 0.02 | 0.029 | 0.028 | 0.03 | 0.031 | 0.0938 |
| $NO_x$ (after LNB install) | 0.06 | 0.06 | 0.06 | - - - | - - - | - - - | - - - | - - - | - - - |
| $SO_2$ | 0.003 | 0.003 | 0.003 | 0.003 | 0.002 | 0.003 | 0.002 | 0.004 | 0.003 |
| CO | 0.082 | 0.082 | 0.082 | 0.032 | 0.0014 | 0 | 0.03 | 0.01 | 0.0788 |
| PM | 0.0074 | 0.0074 | 0.0074 | 0.0074 | 0.0063 | 0.0025 | 0.0074 | 0.0071 | 0.0071 |
| $PM_{10}$ | 0.0074 | 0.0074 | 0.0074 | 0.0074 | 0.0063 | 0.0025 | 0.0074 | 0.0071 | 0.0071 |
| $PM_{2.5}$ | 0.0074 | 0.0074 | 0.0074 | 0.0023 | 0.0023 | 0.0023 | 0.0023 | 0.0071 | 0.0071 |
| VOC | 0.0053 | 0.0053 | 0.0053 | 0.0053 | 0.0004 | 0.0009 | 0.0050 | 0.0052 | 0.0052 |
| Lead | 4.9E-07 | 4.9E-07 | 4.9E-07 | 4.9E-07 | 4.9E-07 | 4.9E-07 | 4.9E-07 | 4.7E-07 | 4.7E-07 |
| $CO_2e$ | 117.1 | 117.1 | 117.1 | 117.1 | 117.1 | 117.1 | 117.1 | 117.1 | 117.1 |

| Baseline Actual Emissions (TPY) | 864 | | | | 870 | | | 1332 | |
|---|---|---|---|---|---|---|---|---|---|
| | PH-1 | PH-11 | PH-12 | PH-13 | H-1 | H-2 | H-3 | H-2 | H-3 |
| $NO_x$ | 22.33 | 25.68 | 26.73 | 0 | 4.54 | 3.88 | 0 | 4.33 | 9.91 |
| $SO_2$ | 0.38 | 0.49 | 0.61 | 0 | 0.36 | 0.37 | 0 | 0.51 | 0.33 |
| CO | 10.92 | 14.47 | 18.35 | 0 | 0.21 | 0.00 | 0 | 1.40 | 8.33 |
| PM | 0.99 | 1.31 | 1.66 | 0 | 0.98 | 0.35 | 0 | 1.00 | 0.75 |
| $PM_{10}$ | 0.99 | 1.31 | 1.66 | 0 | 0.98 | 0.35 | 0 | 1.00 | 0.75 |
| $PM_{2.5}$ | 0.99 | 1.31 | 1.66 | 0 | 0.36 | 0.32 | 0 | 1.00 | 0.75 |
| VOC | 0.72 | 0.95 | 1.20 | 0 | 0.06 | 0.13 | 0 | 0.72 | 0.55 |
| Lead | 6.5E-05 | 8.6E-05 | 1.1E-04 | 0 | 7.6E-05 | 6.7E-05 | 0 | 6.6E-05 | 5.0E-05 |
| $CO_2e$ | 15,657 | 20,740 | 26,306 | 0 | 18,336 | 16,240 | 0 | 16,360 | 12,371 |

| Pollutant | 864 Potential Emissions (TPY) | | | | 870 Potential Emissions (TPY) | | | 1332 Projected Actual Emissions (TPY) | |
|---|---|---|---|---|---|---|---|---|---|
| | PH-1 | PH-11 | PH-12 | PH-13 | H-1 | H-2 | H-3 | H-2 | H-3 |
| $NO_x$ | 19.68 | 19.45 | 22.36 | 6.48 | 12.32 | 6.50 | 14.45 | 5.94 | 11.53 |
| $SO_2$ | 0.92 | 0.91 | 1.01 | 0.87 | 0.98 | 0.62 | 1.11 | 0.70 | 0.39 |
| CO | 26.79 | 26.47 | 30.44 | 9.72 | 0.58 | 0.00 | 14.45 | 1.92 | 9.68 |
| PM | 2.42 | 2.40 | 2.75 | 2.27 | 2.66 | 0.59 | 3.56 | 1.37 | 0.88 |
| $PM_{10}$ | 2.42 | 2.40 | 2.75 | 2.27 | 2.66 | 0.59 | 3.56 | 1.37 | 0.88 |
| $PM_{2.5}$ | 2.42 | 2.40 | 2.75 | 0.70 | 0.97 | 0.53 | 1.10 | 1.37 | 0.88 |
| VOC | 1.75 | 1.73 | 1.99 | 1.62 | 0.17 | 0.21 | 2.41 | 0.99 | 0.63 |
| Lead | 1.6E-04 | 1.6E-04 | 1.8E-04 | 1.5E-04 | 2.1E-04 | 1.1E-04 | 2.3E-04 | 9.0E-05 | 5.8E-05 |
| $CO_2e$ | 38,415 | 37,953 | 43,646 | 35,902 | 49,750 | 27,183 | 56,417 | 22,439 | 14,389 |

| Emissions Increases (TPY) | 864 (PTE - BAE in TPY) | | | | 870 (PTE - BAE in TPY) | | | 1332 (PAE - BAE in TPY) | |
|---|---|---|---|---|---|---|---|---|---|
| | PH-1 | PH-11 | PH-12 | PH-13 | H-1 | H-2 | H-3 | H-2 | H-3 |
| $NO_x$ | -2.65 | -6.24 | -4.37 | 6.48 | 7.78 | 2.62 | 14.45 | 1.61 | 1.62 |
| $SO_2$ | 0.55 | 0.41 | 0.40 | 0.87 | 0.62 | 0.25 | 1.11 | 0.19 | 0.05 |
| CO | 15.87 | 12.01 | 12.10 | 9.72 | 0.37 | 0.00 | 14.45 | 0.52 | 1.36 |
| PM | 1.44 | 1.09 | 1.09 | 2.27 | 1.68 | 0.24 | 3.56 | 0.37 | 0.12 |
| $PM_{10}$ | 1.44 | 1.09 | 1.09 | 2.27 | 1.68 | 0.24 | 3.56 | 0.37 | 0.12 |
| $PM_{2.5}$ | 1.44 | 1.09 | 1.09 | 0.70 | 0.61 | 0.21 | 1.10 | 0.37 | 0.12 |
| VOC | 1.04 | 0.79 | 0.79 | 1.62 | 0.10 | 0.09 | 2.41 | 0.27 | 0.09 |
| Lead | 9.4E-05 | 7.1E-05 | 7.2E-05 | 1.5E-04 | 1.3E-04 | 4.5E-05 | 2.3E-04 | 2.4E-05 | 8.1E-06 |
| $CO_2e$ | 22,758 | 17,213 | 17,341 | 35,902 | 31,413 | 10,943 | 56,417 | 6,079 | 2,018 |

**PES Refinery**
**Tier 3 Project Emissions**
**April 2016**

**864 PH-7 Shutdown Summary**

| Pollutant | 2012 | 2013 | 2014 | 2012/2013 | 2013/2014 | June '12 - May '14 |
|---|---|---|---|---|---|---|
| $NO_x$ | 5.47 | 12.72 | 9.86 | 9.09 | 11.29 | 10.15 |
| $SO_2$ | 0.28 | 0.36 | 0.29 | 0.32 | 0.33 | 0.33 |
| CO | 9.16 | 10.77 | 8.06 | 9.97 | 9.42 | 9.93 |
| PM | 0.83 | 0.97 | 0.73 | 0.90 | 0.85 | 0.90 |
| VOC | 0.60 | 0.71 | 0.53 | 0.65 | 0.62 | 0.65 |
| $CO_2e$ | 11,790 | 14,959 | 11,227 | 13,374 | 13,093 | 13,511 |
| Lead | 5.5E-05 | 6.4E-05 | 4.9E-05 | 5.9E-05 | 5.6E-05 | 5.9E-05 |

**PES Refinery**
**Tier 3 Project Emissions**
**April 2016**

**<u>Unit 864 PH-13 Heater (Replacement from Eagle Point Refinery)</u>**

| Fired Duty (MMBtu/hr) | 70.0 | | |
|---|---|---|---|
| Pollutant | lb/hr | TPY | lb/MMBtu |
| CO | 2.22 | 9.7 | 0.032 |
| $NO_x$ | 1.48 | 6.5 | 0.02 |
| $PM_{10}$ | 0.52 | 2.3 | 0.0074 |
| $SO_2$ | 0.20 | 0.9 | 0.003 |
| VOC | 0.37 | 1.6 | 0.0053 |
| Lead | 3.4E-05 | 1.5E-04 | 4.9E-07 |
| $CO_2e$ | 8,197 | 35,902 | 117.1 |

**PES Refinery**
**Tier 3 Project Emissions**
**April 2016**

**Unit 870 H-3 Heater (New Heater)**

| Fired Duty (MMBtu/hr) | 110.0 | | |
|---|---|---|---|
| Pollutant | lb/hr | TPY | lb/MMBtu |
| CO | 3.3 | 14.5 | 0.030 |
| $NO_x$ | 3.3 | 14.5 | 0.03 |
| $PM_{10}$ | 0.81 | 3.6 | 0.0074 |
| $SO_2$ | 0.25 | 1.1 | 0.002 |
| VOC | 0.55 | 2.4 | 0.0050 |
| Lead | 5.3E-05 | 2.3E-04 | 4.9E-07 |
| $CO_2e$ | 12,881 | 56,417 | 117.1 |

**PES Refinery**
**Tier 3 Project Emissions**
**April 2016**

**Fired Heater $SO_2$ Emissions**

| Heater | 2013 Firing (MMBtu) | 2013 $SO_2$ Emissions (tons) | 2014 Firing (MMBtu) | 2014 $SO_2$ Emissions (tons) | 24 Month Average (lb $SO_2$/MMBtu) |
|---|---|---|---|---|---|
| 864 PH-1 | 269,202 | 0.37 | 274,304 | 0.39 | 0.0028 |
| 864 PH-11 | 372,326 | 0.52 | 296,766 | 0.42 | 0.0028 |
| 864 PH-12 | 468,212 | 0.64 | 356,643 | 0.48 | 0.0027 |
| 870 H-1 | 296,138 | 0.28 | 273,065 | 0.37 | 0.0023 |
| 870 H-2 | 278,182 | 0.35 | 260,841 | 0.37 | 0.0027 |
| 1332 H-2 | 261,616 | 0.41 | 330,380 | 0.68 | 0.0037 |
| 1332 H-3 | 201,939 | 0.28 | 232,411 | 0.41 | 0.0032 |

**Incremental Cooling Tower Emissions**

| Parameter | Value |
|---|---|
| Unit Name | 864 Cooling Tower |
| Number of Units | 1 |
| Design Water Flow Rate (gpm) | 600 |
| Cooling Tower Drift Rate (% of circulating water) | 0.005 |
| Total Dissolved Solids (ppm) | 600 |
| Cycles of Concentration Ratio (tower/makeup water) | 4 |
| VOC EF (lb/MMgal) | 0.7 |
| $PM_{10}$ Fraction | 0.8843 |
| $PM_{2.5}$ Fraction | 0.0047 |

| Parameter | PM [1] | $PM_{10}$ [2] | $PM_{2.5}$ [2] | VOC |
|---|---|---|---|---|
| Hourly (lb/hr) | 0.04 | 0.03 | 0.0002 | 0.03 |
| Daily (lb/day) | 0.9 | 0.8 | 0.004 | 0.60 |
| Annual (TPY) | 0.2 | 0.1 | 0.001 | 0.11 |

[1] PM calculated based on flow rate, drift rate, and total dissolved solids.
[2] Reisman, J. and Frisbie, G., "Calculating Realistic PM10 Emissions From Cooling Towers."

Factors:

| | |
|---|---|
| 60 | min/hr |
| 8.345 | water density (CWS) |
| 8760 | hr/yr |
| 2000 | lb/ton |

***Example from Reisman/Frisbie Paper***

| EPRI Droplet Diameter (μm) | Droplet Volume ($\mu m^3$) | Droplet Mass (μg) | Particle Mass (Solids) (μg) | Solid Particle Volume ($\mu m^3$) | Solid Particle Diameter (μm) | EPRI % Mass Smaller |
|---|---|---|---|---|---|---|
| 10 | 524 | 5.24E-04 | 3.14E-07 | 0.14 | 0.649 | 0.000 |
| 20 | 4189 | 4.19E-03 | 2.51E-06 | 1.14 | 1.297 | 0.196 |
| 30 | 14137 | 1.41E-02 | 8.49E-06 | 3.86 | 1.946 | 0.226 |
| 40 | 33510 | 3.35E-02 | 2.01E-05 | 9.14 | 2.595 | 0.514 |
| 50 | 65450 | 6.55E-02 | 3.93E-05 | 17.86 | 3.243 | 1.816 |
| 60 | 113097 | 1.13E-01 | 6.79E-05 | 30.86 | 3.892 | 5.702 |
| 70 | 179594 | 1.80E-01 | 1.08E-04 | 49.01 | 4.540 | 21.348 |
| 90 | 381704 | 3.82E-01 | 2.29E-04 | 104.16 | 5.838 | 49.812 |
| 110 | 696910 | 6.97E-01 | 4.18E-04 | 190.18 | 7.135 | 70.509 |
| 130 | 1150347 | 1.15E+00 | 6.91E-04 | 313.92 | 8.432 | 82.023 |
| 150 | 1767146 | 1.77E+00 | 1.06E-03 | 482.24 | 9.729 | 88.012 |
| 180 | 3053628 | 3.06E+00 | 1.83E-03 | 833.31 | 11.675 | 91.032 |
| 210 | 4849048 | 4.85E+00 | 2.91E-03 | 1323.26 | 13.621 | 92.468 |
| 240 | 7238229 | 7.24E+00 | 4.35E-03 | 1975.25 | 15.567 | 94.091 |
| 270 | 10305995 | 1.03E+01 | 6.19E-03 | 2812.41 | 17.513 | 94.689 |
| 300 | 14137167 | 1.41E+01 | 8.49E-03 | 3857.90 | 19.459 | 96.288 |
| 350 | 22449298 | 2.25E+01 | 1.35E-02 | 6126.21 | 22.702 | 97.011 |
| 400 | 33510322 | 3.35E+01 | 2.01E-02 | 9144.66 | 25.945 | 98.340 |
| 450 | 47712938 | 4.77E+01 | 2.86E-02 | 13020.42 | 29.188 | 99.071 |
| 500 | 65449847 | 6.55E+01 | 3.93E-02 | 17860.66 | 32.431 | 99.071 |
| 600 | 113097336 | 1.13E+02 | 6.79E-02 | 30863.22 | 38.918 | 100.000 |

**PES Refinery**
**Tier 3 Project Emissions**
**April 2016**

## Incremental Sulfur Production Emissions

| Parameter | Value | Units |
|---|---|---|
| Total Gasoline Pool Volume | 165,000 | BPD |
| Gasoline specific gravity | 0.71 | |
| Gasoline density | 5.9 | lb/gal |
| Current Sulfur in Gasoline | 30 | ppmw |
| Expected Tier 3 Sulfur in Gasoline | 8.2 | ppmw |
| Total Gasoline Pool Volume | 41,035,302 | lb/day |
| Current Sulfur in Gasoline | 1231.1 | lb/day |
| Tier 3 Sulfur in Gasoline | 336.5 | lb/day |
| Sulfur removed | 894.6 | lb/day |
| **Additional sulfur load** | **0.45** | **ton/day** |

| From 867 (2013) | Total Sulfur (Tons) |
|---|---|
| Jan-13 | 697.7 |
| Feb-13 | 417.3 |
| Mar-13 | 490.1 |
| Apr-13 | 635.8 |
| May-13 | 720.5 |
| Jun-13 | 832.8 |
| Jul-13 | 949.0 |
| Aug-13 | 950.3 |
| Sep-13 | 843.6 |
| Oct-13 | 818.0 |
| Nov-13 | 651.1 |
| Dec-13 | 627.5 |
| **Total** | **8,633.7** |

| 2013 Total Emissions | | |
|---|---|---|
| | **TOTAL SRU $NO_x$ (ton)** | **4.4** |
| | **TOTAL SRU CO (ton)** | **172.2** |
| | **TOTAL SRU $SO_2$ (ton)** | **11.5** |

Total Additional Sulfur Production:

894.6 lb/day = 326,518 lb/yr = 163.3 TPY

| Parameter | Total Sulfur (tons) | $NO_x$ (TPY) | CO (TPY) | $SO_2$ (TPY) |
|---|---|---|---|---|
| Future Total (TPY) | 8,797.0 | 4.5 | 175.5 | 11.7 |
| Increase (TPY) | 163.3 | 0.1 | 3.3 | 0.2 |

**PES Refinery**
**Tier 3 Project Emissions**
**April 2016**

**<u>Fugitive Emission Estimates</u>**

| 864/870/1332 Units | Additional Components | | | |
|---|---|---|---|---|
| | **Valves** | **Flanges** | **Pumps** | **Connectors** |
| Process Modifications* | 125 | 250 | 13 | 0 |
| Default-zero Emission Rate (kg/hr/source)** | 7.8E-06 | 3.1E-07 | 2.4E-05 | 7.5E-06 |
| (lb/yr/source) | 1.5E-01 | 6.0E-03 | 4.6E-01 | 1.5E-01 |

| | | | | |
|---|---|---|---|---|
| **Total VOC Emissions (lb/yr)** | **18.88** | **1.50** | **6.04** | **0** |
| **Total VOC Emissions (lb/yr)** | **26.42** | | | |
| **Total VOC Emissions (lb/hr)** | **0.003** | | | |
| **Total VOC Emissions (TPY)** | **0.013** | | | |

*All component counts are estimated at 115% to allow for final design flexibility
** EPA 1995 Protocol for Equipment Leak Emission Estimates, Table 2-12

*Attachment D*
*Contemporaneous Emissions Tables*

**PES Refinery**
**Summary of PSD Contemporaneous Period Emissions**
**April 2016**

| Facility | Permit No. | Activity | Effective Date of Change[1] | PSD Net Emission Change, Ton/Yr | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $NO_2$ | $SO_2$ | $PM/PM_{10}/PM_{2.5}$ | CO | $H_2SO_4$ | Lead | $CO_2e$ |
| Gir. Pt./Pt. Br. | RFD | 3-Unit Train - Crude Transfer Pipeline | 1/18/2013 | 0.00 | 0.00 | 0.00 | Modeled[3] | 0.00 | 0.00E+00 | 0 |
| Point Breeze | 13001 | Tank P-590 (PB 843) Reactivation[2] | 1/22/2013 | 0.27 | 0.18 | 0.05 | Modeled[3] | 0.00 | 0.00E+00 | 0 |
| Gir. Pt./Pt. Br. | 12270 | Butane Truck Unloading at SRTF | 3/5/2013 | 0.09 | 0.00 | 0.00 | Modeled[3] | 0.00 | 0.00E+00 | 0 |
| Gir. Pt./Pt. Br. | 13020 | 14-Unit Train - Crude Transfer Pipeline | 4/8/2013 | 0.00 | 0.00 | 0.00 | Modeled[3] | 0.00 | 0.00E+00 | 0 |
| Point Breeze | RFD | 210 Light-Ends Improvement Project | 8/21/2013 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00E+00 | 0 |
| Girard Point | RFD | Butane Logistics Project | 1/13/2014 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00E+00 | 0 |
| Gir. Pt./Pt. Br. | 12195 | Heater Firing Rate Increase (7-Heater) | 2/19/2014 | 237.42 | 12.57 | 20.31 | Modeled[3] | 0.00 | 1.77E-03 | 261,670 |
| Point Breeze | RFD | 210 VTB Cooling | 3/21/2014 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00E+00 | 0 |
| Girard Point | 14045 | Butane Railcar Unloading | 4/08/2014 | 0.56 | 0.04 | 0.11 | 1.31 | 0.00 | 0.00E+00 | 1,239 |
| Point Breeze | 13260 | South Yard South Flare | 7/18/2014 | 1.44 | 0.03 | 0.06 | 6.92 | 0.00 | 0.00E+00 | 618 |
| Point Breeze | RFD | 868 TCSS Distillate Recovery | 6/9/2014 | 1.00 | 0.08 | 0.20 | 2.07 | 0.00 | 0.00E+00 | 0 |
| Girard Point | RFD | 1232 Distillate Recovery | 7/25/2014 | 2.08 | 0.03 | 0.39 | 5.60 | 0.00 | 0.00E+00 | 0 |
| Point Breeze | RFD | PB 210 V2 Stripper | 7/25/2014 | 0.48 | -6.85 | -3.35 | 1.63 | 0.00 | 0.00E+00 | 0 |
| Girard Point | 14219-14220 | Butane Terminal Firewater Pumps | 8/11/2014 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00E+00 | 0 |
| Point Breeze | 14237 | Tank PB 36 (P-010) Gasoline Storage | 8/29/2014 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00E+00 | 0 |
| Gir. Pt./Pt. Br. | 14149 | Boiler 45 | 9/2/2014 | 5.06 | 15.15 | 6.13 | 5.69 | 2.32 | 7.61E-04 | 182,774 |
| Girard Point | RFD | 1332 C-703 Steam Heat Exchanger | 10/9/2014 | 0.21 | 0.00 | 0.01 | 0.13 | 0 | 0 | 0 |
| Point Breeze | RFD | 868 LCO Recovery Improvements | 10/16/2014 | 0.75 | 0.14 | 0.16 | 2.65 | 0 | 0 | 0 |
| Point Breeze | RFD | 210C VTB Direct to 868 | 11/17/2014 | 0.21 | 0.34 | 0.19 | 0.85 | 0 | 0 | 0 |
| Point Breeze | RFD | 137 Depropanizer Feed | 10/16/2014 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| Girard Point | RFD | 433 Propane Processing Improvements | 10/28/2014 | 1.00 | 0.07 | 0.20 | 2.22 | 0 | 0 | 0 |
| Point Breeze | RFD | 210 Debutanizer Cooling | Pending | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| Girard Point | RFD | 1232 Absorber/ Stripper Tower | 12/8/2014 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| Point Breeze | 14368 | Tank PB-848 Crude Storage | Withdrawn March 2016 | - - - | - - - | - - - | - - - | - - - | - - - | - - - |
| Point Breeze | 14369 | Tank PB-844 Crude Storage | Withdrawn March 2016 | - - - | - - - | - - - | - - - | - - - | - - - | - - - |
| Girard Point | RFD | GP 433 Emergency Relief | 12/2/2014 | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| Point Breeze | RFD | HDS Field Charge Pump | 12/16/2014 | 0.06 | 0.20 | 0.13 | 2.26 | 0 | 0 | 0 |
| Girard Point | RFD | Crude Off-loading Flexibility | Pending | 0.00 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| Point Breeze | RFD | Tank PB-880 Crude Storage | Withdrawn March 2016 | - - - | - - - | - - - | - - - | - - - | - - - | - - - |
| Point Breeze | RFD | Tank PB-850 Crude Storage | Withdrawn March 2016 | - - - | - - - | - - - | - - - | - - - | - - - | - - - |
| Point Breeze | Application | Unit 864 PH-1, Unit 864 PH-11, Unit 864 PH-12 Heater Burner Replacements | Application | -11.91 | 0.00 | 0.00 | 0.00 | 0 | 0 | 0 |
| Point Breeze | Application | Replacement of 864 PH-7 | Application | -11.29 | -0.33 | -0.85 | -9.42 | 0 | 0 | -13,093 |
| **5-year increases and decreases from 1st Quarter 2015** | | | | **227.42** | **21.64** | **23.74** | **21.91** | **2.32** | **2.53E-03** | **433,208** |

Notes:

1 The Effective Date of Change for emissions increases is considered the date of permit issuance and for emissions reductions it is the date of source shutdown.

2 Tank P-590 (PB 843) includes emissions from steam from No. 3 Boiler House that were already permitted in No. 3 Boiler House NOx Reduction Project in 2008.

3 Plan Approval 12195 triggered PSD Modeling for CO, which showed no CO concentration from project and contemporaneous projects that were above the CO SIL. Therefore, all increases from 9/9/2008 through 9/6/13 (date of application) are excluded from future project netting.

**PES Refinery**
**Summary of NANSR Contemporaneous Period Emissions**
**April 2016**

**25 Pa Code 127.203(b)(1)(i) 5 Calendar Year Increases**

| Facility | Permit No. | Activity | Effective Date of Change[1] | NANSR Net Emission Change, Ton/Yr | |
|---|---|---|---|---|---|
| | | | | VOC | $NO_x$ |
| Gir. Pt./Pt. Br. | RFD | 3-Unit Train - Crude Transfer Pipeline | 1/18/2013 | Offset[2] | 0.00 |
| Point Breeze | 13001 | Tank P-590 (PB 843) Reactivation[3] | 1/22/2013 | Offset[2] | Offset[2] |
| Gir. Pt./Pt. Br. | 12270 | Butane Truck Unloading at SRTF | 3/5/2013 | Offset[2] | Offset[2] |
| Gir. Pt./Pt. Br. | 13020 | 14-Unit Train - Crude Transfer Pipeline | 4/8/2013 | Offset[2] | 0.00 |
| Point Breeze | RFD | 210 Light-Ends Improvement Project | 8/21/2013 | 0.01 | 0.00 |
| Girard Point | RFD | Butane Logistics Project | 1/13/2014 | 0.0005 | 0.00 |
| Gir. Pt./Pt. Br. | 12195 | Heater Firing Rate Increase (7-Heater) | 2/19/2014 | Offset[2] | Offset[2] |
| Point Breeze | RFD | 210 VTB Cooling | 3/21/2014 | 0.002 | 0.00 |
| Girard Point | 14045 | Butane Railcar Unloading | 4/08/2014 | 2.70 | 0.56 |
| Point Breeze | 13260 | South Yard South Flare | 7/18/2014 | 2.42 | 1.44 |
| Point Breeze | RFD | 868 TCSS Distillate Recovery | 6/9/2014 | 0.15 | 1.00 |
| Girard Point | RFD | 1232 Distillate Recovery | 7/25/2014 | 0.30 | 2.08 |
| Point Breeze | RFD | PB 210 V2 Stripper | 7/25/2014 | 0.15 | 0.48 |
| Girard Point | 14219-14220 | Butane Terminal Firewater Pumps | 8/11/2014 | 0.00 | 0.00 |
| Gir. Pt./Pt. Br. | 14149 | Boiler 45 | 9/2/2014 | 1.45 | 5.06 |
| Girard Point | RFD | 1332 C-703 Steam Heat Exchanger | 10/09/2014 | 0.01 | 0.21 |
| Point Breeze | RFD | 868 LCO Recovery Improvements | 10/16/2014 | 0.11 | 0.75 |
| Point Breeze | RFD | 210C VTB Direct to 868 | 11/17/2014 | 0.03 | 0.21 |
| Point Breeze | RFD | 137 Depropanizer Feed | 10/16/2014 | 0.00 | 0.00 |
| Girard Point | RFD | 433 Propane Processing Improvements | 10/28/2014 | 0.16 | 1.00 |
| Point Breeze | RFD | 210 Debutanizer Cooling | Pending | 0.00 | 0.00 |
| Girard Point | RFD | 1232 Absorber/ Stripper Tower | 12/8/2014 | 0.03 | 0.00 |
| Point Breeze | 14368 | Tank PB-848 Crude Storage | Withdrawn March 2016 | - - - | - - - |
| Point Breeze | 14369 | Tank PB-844 Crude Storage | Withdrawn March 2016 | - - - | - - - |
| Girard Point | RFD | GP 433 Emergency Relief | 12/2/2014 | 0.00 | 0.00 |
| Point Breeze | RFD | HDS Field Charge Pump | 12/16/2014 | 0.09 | 0.06 |
| Girard Point | RFD | Crude Off-loading Flexibility | 1/8/2015 | 0.00 | 0.00 |
| SRTF | RFD | Butane Blending at SRTF | 3/2/2015 | 0.00 | 0.00 |
| Point Breeze | RFD | Tank PB-880 Crude Storage | Withdrawn March 2016 | - - - | - - - |
| Point Breeze | RFD | Tank PB-850 Crude Storage | Withdrawn March 2016 | - - - | - - - |
| SRTF | Pending | Butane Compressor | Pending | 0.01 | 0.00 |
| Point Breeze | 14237 | Tank PB 36 (P-010) Gasoline Storage | Pending | 0.97 | 0.00 |
| **5-calendar year increases from 1st Quarter 2015[4,5]** | | | | **8.59** | **12.84** |

Notes:

1 The Effective Date of Change for emissions increases is considered the date of permit issuance and for emissions reductions it is the date of source shutdown.

2 Plan Approval 12195 triggered NSR for VOC & $NO_x$. All increases from calendar years 2009 through 9/6/13 (date of application) were offset.

3 Tank P-590 (PB 843) includes emissions from steam from No. 3 Boiler House that were already permitted in No. 3 Boiler House $NO_x$ Reduction Project in 2008.

4 NSR contemporaneous period for VOC and $NO_x$ is 5 calendar years (the year of modification plus back 4 more years).

5 Consent Decree emissions credits from the shutdown of the Marcus Hook 10-4 FCC and LSG units are not available except in certain situations as described in the Consent Decree.

**PES Refinery**
**Summary of NANSR Contemporaneous Period Emissions**
**April 2016**

**25 Pa Code 127.203(b)(1)(ii) 10 Year Increases/Decreases**

| Facility | Permit No. | Activity | Effective Date of Change[1] | NANSR Net Emission Change, Ton/Yr | |
|---|---|---|---|---|---|
| | | | | VOC | $NO_x$ |
| Gir. Pt./Pt. Br. | 04322 | 1232 Flue Gas Treating & Expansion | 2/28/2006 | 0.00 | 0.00 |
| Point Breeze | 05219 | 866 Unit Modification for ULSD mode | 3/7/2006 | 0.00 | 0.00 |
| Girard Point | NA | Demin. valves and flanges at Units 433/869 | 2006 | 0.00 | 0.00 |
| Girard Point | 06050 | 433 HFAU Process Improvement Project | 12/4/2006 | 0.00 | 0.00 |
| Girard Point | 07026 | 231 Imported Jet Project | 6/13/2007 | 0.00 | 0.00 |
| Gir. Pt./Pt. Br. | 06144 | 859 ULSD Project[3] | 1/29/2008 | 0.00 | 0.00 |
| Girard Point | 08080 | No. 3 Boiler House $NO_x$ Reduction | 9/9/2008 | 12.52 | 0.00 |
| Girard Point | RFD | Unit 433 KOH Treater Lines | 10/23/2008 | 0.01 | 0.19 |
| Point Breeze | RFD | Unit 866 Stripper Valve | 12/22/2008 | 0.30 | 0.06 |
| Point Breeze | 08255 | Unit 865 Improvement Project | 2/23/2009 | 0.97 | 9.42 |
| Girard Point | 09022 | Unit 137 RFG Changes | 3/3/2009 | 0.02 | 0.00 |
| Girard Point | 09116 | Unit 433 ASO to Unit 137 Desalter | 6/5/2009 | 0.02 | 0.00 |
| Girard Point | 09040 | Unit 1332 Heater SEP | 2/1/2010 | 0.03 | 0.87 |
| Point Breeze | non permit letter | Tk 33/35 Jump-over line | 11/23/2010 | 0.03 | 0.00 |
| Gir. Pt./Pt. Br. | RFD | 3-Unit Train - Crude Transfer Pipeline | 1/18/2013 | Offset[5] | 0.00 |
| Point Breeze | 13001 | Tank P-590 (PB 843) Reactivation[4] | 1/22/2013 | Offset[5] | Offset[5] |
| Gir. Pt./Pt. Br. | 12270 | Butane Truck Unloading at SRTF | 3/5/2013 | Offset[5] | Offset[5] |
| Gir. Pt./Pt. Br. | 13020 | 14-Unit Train - Crude Transfer Pipeline | 4/8/2013 | Offset[5] | 0.00 |
| Point Breeze | RFD | 210 Light-Ends Improvement Project | 8/21/2013 | 0.01 | 0.00 |
| Girard Point | RFD | Butane Logistics Project | 1/13/2014 | 0.0005 | 0.00 |
| Gir. Pt./Pt. Br. | 12195 | Heater Firing Rate Increase (7-Heater)[5] | 2/19/2014 | Offset[5] | Offset[5] |
| Point Breeze | RFD | 210 VTB Cooling | 3/21/2014 | 0.002 | 0.00 |
| Girard Point | 14045 | Butane Railcar Unloading | 4/08/2014 | 2.70 | 0.56 |
| Point Breeze | 13260 | South Yard South Flare | 7/18/2014 | 2.42 | 1.44 |
| Point Breeze | RFD | 868 TCSS Distillate Recovery | 6/9/2014 | 0.15 | 1.00 |
| Girard Point | RFD | 1232 Distillate Recovery | 7/25/2014 | 0.30 | 2.08 |
| Point Breeze | RFD | PB 210 V2 Stripper | 7/25/2014 | 0.15 | 0.48 |
| Girard Point | 14219-14220 | Butane Terminal Firewater Pumps | 8/11/2014 | 0.00 | 0.00 |
| Point Breeze | 14237 | Tank PB 36 (P-010) Gasoline Storage | 8/29/2014 | 1.30 | 0.00 |
| Gir. Pt./Pt. Br. | 14149 | Boiler 45 | 9/2/2014 | 1.45 | 5.06 |
| Girard Point | RFD | 1332 C-703 Steam Heat Exchanger | 10/09/2014 | 0.01 | 0.21 |
| Point Breeze | RFD | 868 LCO Recovery Improvements | 10/16/2014 | 0.11 | 0.75 |
| Point Breeze | RFD | 210C VTB Direct to 868 | 11/17/2014 | 0.03 | 0.21 |
| Point Breeze | RFD | 137 Depropanizer Feed | 10/16/2014 | 0.00 | 0.00 |
| Girard Point | RFD | 433 Propane Processing Improvements | 10/28/2014 | 0.16 | 1.00 |
| Point Breeze | RFD | 210 Debutanizer Cooling | Pending | 0.00 | 0.00 |
| Girard Point | RFD | 1232 Absorber/ Stripper Tower | 12/8/2014 | 0.03 | 0.00 |
| Point Breeze | 14368 | Tank PB-848 Crude Storage | Withdrawn March 2016 | - - - | - - - |
| Point Breeze | 14369 | Tank PB-844 Crude Storage | Withdrawn March 2016 | - - - | - - - |
| Girard Point | RFD | GP 433 Emergency Relief | 12/2/2014 | 0.00 | 0.00 |
| Point Breeze | RFD | HDS Field Charge Pump | 12/16/2014 | 0.09 | 0.06 |
| Girard Point | RFD | Crude Off-loading Flexibility | 1/8/2015 | 0.00 | 0.00 |
| SRTF | RFD | Butane Blending at SRTF | 3/2/2015 | 0.00 | 0.00 |
| Point Breeze | RFD | Tank PB-880 Crude Storage | Withdrawn March 2016 | - - - | - - - |
| Point Breeze | RFD | Tank PB-850 Crude Storage | Withdrawn March 2016 | - - - | - - - |
| SRTF | Pending | Butane Compressor | Pending | 0.01 | 0.00 |
| Point Breeze | 14237 | Tank PB 36 (P-010) Gasoline Storage | Pending | 0.97 | 0.00 |
| Point Breeze | Application | Unit 864 PH-1, Unit 864 PH-11, Unit 864 PH-12 Heater Burner Replacements | Application | 0.00 | 0.00 |
| **10-year increases/decreases from 1st Quarter 2015[6]** | | | | **23.79** | **23.39** |

Notes:

1 The Effective Date of Change for emissions increases is considered the date of permit issuance and for emissions reductions it is the date of source shutdown.

2 Plan Approval 04237 triggered NSR for VOC.

3 Plan Approval 06144 triggered NSR for VOC & $NO_x$.

4 Tank P-590 (PB 843) includes emissions from steam from No. 3 Boiler House that were already permitted in No. 3 Boiler House $NO_x$ Reduction Project in 2008.

5 Plan Approval 12195 triggered NSR for VOC & NOx. All increases from calendar years 2009 through 9/6/13 (date of application) were offset.

6 Consent Decree emissions credits from the shutdown of the Marcus Hook 10-4 FCC and LSG units are not available except in certain situations as described in the Consent Decree.

**PES Refinery**
**Emissions Reduction Credits Available**
**April 2016**

| Facility | Permit No. | Source | Effective Date | Creditable Emissions Reductions, Tons | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | VOC | $NO_x/NO_2$ | $SO_2$ | $PM/PM_{10}/PM_{2.5}$ | CO | $H_2SO_4$ | $CO_2e$ |
| Point Breeze | non permit letter | 22 Boilerhouse #2/#3 | 1/19/2010 | -0.99 | -36.40 | -1.25 | -1.41 | -0.38 | n/a | -49,788 |
| Marcus Hook | non permit letter | 15-1 CRUDE HTR shutdown | 8/16/2012 | -5.05 | -136.46 | -0.15 | -7.02 | -77.24 | n/a | -111,102 |
| Marcus Hook | non permit letter | 17-2A H-01, H-02, H-03 HTR shutdown | 8/16/2012 | -2.72 | -57.04 | -0.05 | -3.75 | -41.19 | n/a | -44,912 |
| Marcus Hook | non permit letter | 17-2A H-04 HTR shutdown | 8/16/2012 | -0.35 | -6.21 | -0.01 | -0.50 | -5.25 | n/a | -8,250 |
| Marcus Hook | non permit letter | 12-3 CRUDE HTR H-3006 shutdown | 8/16/2012 | -4.61 | -89.48 | -0.13 | -6.36 | -70.37 | n/a | -92,084 |
| Marcus Hook | non permit letter | 12-3 DESULF HTR | 8/16/2012 | -0.33 | -6.06 | -0.01 | -0.48 | -5.09 | n/a | -4,819 |
| Marcus Hook | non permit letter | 111 Cooling Towers | 8/16/2012 | -19.94 | 0.00 | 0.00 | -10.24 | 0.00 | n/a | 0 |
| Total ERCs Generated | | | | -33.97 | -331.64 | -1.60 | -29.75 | -199.50 | 0.00 | -310,956 |
| NSR maximum netting credits needed in the 12195 Heater Plan Approval Application | | | | 33.80 | 195.95 | - - - | - - - | - - - | - - - | - - - |
| Total ERCs Remaining* | | | | -0.17 | -135.69 | -1.60 | -29.75 | -199.50 | 0.00 | -310,956 |
| Total ERCs Remaining without Marcus Hook | | | | -0.17 | -36.40 | -1.25 | -1.41 | -0.38 | 0.00 | -49,788 |

Notes:
* PES is in active discussion with AMS regarding the accounting of emission reductions from the former Marcus Hook Refinery that were established while the facility was considered part of the Philadelphia Refining Complex. For the purposes of this application, these reductions are not considered contemporaneous.

| Facility | Permit No. | Source | Effective Date | Fourth Amendment to Consent Decree - Civil Action No. 05-02866 - Available Emissions Credits, Tons | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | VOC | $NO_x$ | $SO_2$ | $PM_{10}/PM_{2.5}$ | CO | $H_2SO_4$ | $CO_2e$ |
| Marcus Hook | Consent Decree | Source 101 10-4 FCC Unit | 8/17/2012 | -1.26 | -92.38 | -128.38 | -315.36 | -364.92 | -56.07 | -894,018.9 |
| Marcus Hook | Consent Decree | Source 040 10-4 Feed Heater | 8/17/2012 | -0.74 | -12.85 | -0.01 | -2.13 | -0.36 | 0 | -3,848.2 |
| Marcus Hook | Consent Decree | Source 705 LSG HDS Heater | 8/17/2012 | -0.13 | -5.14 | -0.01 | -0.29 | -0.01 | 0 | -16,551.0 |
| Marcus Hook | Consent Decree | Source 706 LSG Stabilizer Heater | 8/17/2012 | -0.08 | -1.08 | -0.02 | -0.16 | -0.31 | 0 | -10,868.7 |
| Total Emissions Credits | | | | -2.21 | -111.37 | -128.42 | -317.94 | -365.6 | -56.07 | -922,286.83 |
| Emissions credits needed in the 14149 Boiler 45 Plan Approval Application | | | | - - - | - - - | - - - | - - - | - - - | - - - | 185,133.63 |
| Total Emissions Credits Remaining | | | | -2.21 | -111.37 | -128.42 | -317.94 | -365.6 | -56.07 | -737,153.20 |

Notes:
Consent Decree Emissions Reductions can only be used for emissions units that meet the following criteria:
1 - For heaters and boilers, a limit of 0.020 lbs $NO_x$ per million BTU or less on a 3-hour rolling average basis.
2 - For heaters and boilers, a limit of 162 ppmvd of hydrogen sulfide in fuel gas or 20 ppmvd $SO_2$ corrected to 0% $O_2$ both on a 3-hour rolling average, and 60 ppmv hydrogen sulfide in fuel gas on a 365-day average.
3 - For heaters and boilers, no liquid or solid fuel firing authorization.
4 - For FCCUs, a limit of 20 ppmvd $NO_x$ corrected to 0% $O_2$ or less on a 365-day rolling average basis; a limit of 25 ppmvd $SO_2$ corrected to 0% $O_2$ or less on a 365-day rolling average basis; and a limit of 0.5 pound of PM per 1000 pounds of coke burned on a 3-hour average basis.
5 - For Flaring Devices, 162 ppmv hydrogen sulfide in gas burned in the flare on a 3-hour rolling average.
6 - For Sulfur Recovery Plants, NSPS Subpart Ja emission limits.
7 - For emissions units other than those listed in items 1 through 6 above at which credits are being used, Best Available Control Technology ("BACT"), Best Available Technology ("BAT") or Lowest Achievable Emission Rate ("LAER"), as determined by AMS.

*Attachment E*
*Best Available Technology $NO_x$ Control Cost Effectiveness Calculations*

**PES Refinery**
**Tier 3 Project**
**BAT Control Cost Effectiveness Summary**

| | A | B | C | D | E | F | G | H | I | J |
|---|---|---|---|---|---|---|---|---|---|---|
| Control Option | Potential Firing Rates (MMBtu/hr) | Current Emission Rate (lb/MMBtu) | Potential Emissions (TPY) | Control Efficiency (%) | Maximum Post Control Emissions (TPY) | Potential $NO_x$ Reduced (TPY) | 2013 Total Capital Cost ($) | 2013 O&M Cost ($) | 2013 Annualized Cost[1] ($) | 2013 Cost Effectiveness ($/Ton) |
| Unit 864 PH-13 Heater - SCR[1] | 70.0 | 0.02 | 6.5 | 85% | 1.0 | 5.5 | 3,153,207 | 109,882 | 757,414 | 137,461 |
| Unit 870 H-3 Heater - SCR | 110.0 | 0.03 | 14.5 | 85% | 2.2 | 12.3 | 4,138,885 | 150,847 | 1,000,794 | 81,459 |
| Calculation | | | = A * B * 8760 / 2000 | | = C * (1 - D) | = C - E | | | = (G * ACF) + H | = I / F |

[1] SCR = Selective Catalytic Reduction

Assumptions:

| | |
|---|---|
| Number of Years (n) | 20 |
| Interest Rate, % (i) | 20 |
| Annualized Cost Factor (ACF) | 0.21 |

$$ACF = \frac{i(1+i)^n}{(1+i)^n - 1}$$

| Year | *Chemical Engineering* Cost Index |
|---|---|
| 1986 | 318.4 |
| 1991 | 361 |
| 2013 | 567.3 |
| Cost Escalation Factor for SCR[1] | 1.78 |
| Cost Escalation Factor for Utilities[2] | 1.57 |

[1] Cost data from *Alternative Control Techniques Document - $NO_x$ Emissions from Process Heaters (Revised)* - EPA-453/R-93-034 scaled from 1986 to 2012 costs using the Cost Escalation Factor.

[2] Cost data from *Alternative Control Techniques Document - $NO_x$ Emissions from Process Heaters (Revised)* - EPA-453/R-93-034 scaled from 1991 to 2012 costs using the Cost Escalation Factor.

**PES Refinery**
**Tier 3 Project**
**Unit 864 PH-13 BAT Control Cost Effectiveness**

| | | |
|---|---|---|
| **Source** | **Unit 864 PH-13** | |
| **Control** | **SCR** | |
| **Rated Heat Input** | **70.0** | **MMBtu/hr** |
| **Baseline Actual Emissions** | **6.5** | **tpy** |
| **Current Emission Rate** | **0.02** | **lb/MMBtu** |
| **Control Efficiency** | **85%** | |
| **Heater Capacity** | **73.9** | **GJ/hr** |

**Evaluated at New Firing Limit at 2013 Cost and Efficiencies**
**Costs derived from** ***Alternative Control Techniques Document - NOx Emissions from Process Heaters (Revised)*** **- EPA-453/R-93-034**

| | **COST COMPONENT:** | **COST ($)** |
|---|---|---|
| *DIRECT COSTS* | | |
| | *Purchased Equipment Costs* | |
| | Equipment Cost (EC) | 3,061,366 |
| | Instrumentation (Included in above costs) | - - - |
| | Sales taxes (Included in above costs) | - - - |
| | Freight (Included in above costs) | - - - |
| | ***Subtotal - Purchased Equipment Costs (PEC)*** | **3,061,366** |
| | *Direct Installation Costs* | |
| | Foundations & supports; handling & erection; electrical; piping; etc. | 0 |
| | Site Preparation / Buildings- Included above | - - - |
| | ***Subtotal - Direct Installation Costs*** | **0** |
| *TOTAL DIRECT COSTS (TDC)* | | **3,061,366** |
| *INDIRECT INSTALLATION COSTS* | | |
| | Engineering Costs (Included in above costs) | - - - |
| | Construct. & Field Expenses (Included in above costs) | - - - |
| | Contractor Fees (Included in above costs) | - - - |
| | Start-up (Included in above costs) | - - - |
| | Performance Test (Included in above costs) | - - - |
| | Contingency (3% of PEC) | 91,841 |
| *TOTAL INDIRECT COSTS, IC* | | **91,841** |
| **TOTAL CAPITAL INVESTMENT (TCI)** | | **3,153,207** |

**PES Refinery**
**Tier 3 Project**
**Unit 864 PH-13 BAT Control Cost Effectiveness**

| | | |
|---|---|---|
| **Source** | **Unit 864 PH-13** | |
| **Control** | **SCR** | |
| **Rated Heat Input** | **70.0** | **MMBtu/hr** |
| **Baseline Actual Emissions** | **6.5** | **tpy** |
| **Current Emission Rate** | **0.02** | **lb/MMBtu** |
| **Control Efficiency** | **85%** | |
| **Heater Capacity** | **73.9** | **GJ/hr** |

| COST COMPONENT: | COST ($) |
|---|---|
| *ANNUAL DIRECT COSTS* | |
| *Operation and Maintenance Labor* | |
| Maintenance Labor and Material (2.75% of TCI) | 86,713 |
| | **86,713** |
| *Utilities* | |
| Ammonia Cost | 941 |
| Catalyst Replacement Cost | 22,227 |
| Electricity Cost | 0.1 |
| ***Subtotal - Utilities*** | **23,169** |
| **TOTAL ANNUAL DIRECT COSTS** | **109,882** |

| COST COMPONENT: | | COST ($) |
|---|---|---|
| ***TOTAL ANNUAL O&M COSTS*** | | **109,882** |
| *Annualized Cost Factor* | | |
| Equipment Life (years) = | 20 | |
| Interest Rate (%) = | 20 | |
| Annualized Cost Factor | | 0.21 |
| *CAPITAL RECOVERY COSTS* | | |
| *TOTAL CAPITAL REQUIREMENT* | | 3,153,207 |
| ***TOTAL ANNUAL CAPITAL REQUIREMENT*** | | **647,532** |
| ***TOTAL ANNUALIZED COST*** <br> ***(Total annual O&M cost and annualized capital cost)*** | | **757,414** |

**PES Refinery**
**Tier 3 Project**
**Unit 870 H-3 BAT Control Cost Effectiveness**

| | | |
|---|---|---|
| **Source** | **Unit 870 H-3** | |
| **Control** | **SCR** | |
| **Rated Heat Input** | **110.0** | **MMBtu/hr** |
| **Baseline Actual Emissions** | **14.5** | **tpy** |
| **Current Emission Rate** | **0.03** | **lb/MMBtu** |
| **Control Efficiency** | **85%** | |
| **Heater Capacity** | **116.1** | **GJ/hr** |

**Evaluated at New Firing Limit at 2013 Cost and Efficiencies**
**Costs derived from** ***Alternative Control Techniques Document - NOx Emissions from Process Heaters (Revised)*** **- EPA-453/R-93-034**

| | **COST COMPONENT:** | **COST ($)** |
|---|---|---|
| *DIRECT COSTS* | | |
| | *Purchased Equipment Costs* | |
| | Equipment Cost (EC) | 4,018,335 |
| | Instrumentation (Included in above costs) | - - - |
| | Sales taxes (Included in above costs) | - - - |
| | Freight (Included in above costs) | - - - |
| | ***Subtotal - Purchased Equipment Costs (PEC)*** | **4,018,335** |
| | *Direct Installation Costs* | |
| | Foundations & supports; handling & erection; electrical; piping; etc. | 0 |
| | Site Preparation / Buildings- Included above | - - - |
| | ***Subtotal - Direct Installation Costs*** | **0** |
| *TOTAL DIRECT COSTS (TDC)* | | **4,018,335** |
| *INDIRECT INSTALLATION COSTS* | | |
| | Engineering Costs (Included in above costs) | - - - |
| | Construct. & Field Expenses (Included in above costs) | - - - |
| | Contractor Fees (Included in above costs) | - - - |
| | Start-up (Included in above costs) | - - - |
| | Performance Test (Included in above costs) | - - - |
| | Contingency (3% of PEC) | 120,550 |
| *TOTAL INDIRECT COSTS, IC* | | **120,550** |
| **TOTAL CAPITAL INVESTMENT (TCI)** | | **4,138,885** |

**PES Refinery**
**Tier 3 Project**
**Unit 870 H-3 BAT Control Cost Effectiveness**

| | | |
|---|---|---|
| **Source** | **Unit 870 H-3** | |
| **Control** | **SCR** | |
| **Rated Heat Input** | **110.0** | **MMBtu/hr** |
| **Baseline Actual Emissions** | **14.5** | **tpy** |
| **Current Emission Rate** | **0.03** | **lb/MMBtu** |
| **Control Efficiency** | **85%** | |
| **Heater Capacity** | **116.1** | **GJ/hr** |

| **COST COMPONENT:** | **COST ($)** |
|---|---|
| *ANNUAL DIRECT COSTS* | |
| *Operation and Maintenance Labor* | |
| Maintenance Labor and Material (2.75% of TCI) | 113,819 |
| | **113,819** |
| *Utilities* | |
| Ammonia Cost | 2,099 |
| Catalyst Replacement Cost | 34,929 |
| Electricity Cost | 0.2 |
| ***Subtotal - Utilities*** | **37,027** |
| **TOTAL ANNUAL DIRECT COSTS** | **150,847** |

| **COST COMPONENT:** | | **COST ($)** |
|---|---|---|
| ***TOTAL ANNUAL O&M COSTS*** | | **150,847** |
| *Annualized Cost Factor* | | |
| Equipment Life (years) = | 20 | |
| Interest Rate (%) = | 20 | |
| Annualized Cost Factor | | 0.21 |
| *CAPITAL RECOVERY COSTS* | | |
| *TOTAL CAPITAL REQUIREMENT* | | 4,138,885 |
| ***TOTAL ANNUAL CAPITAL REQUIREMENT*** | | **849,947** |
| ***TOTAL ANNUALIZED COST*** ***(Total annual O&M cost and annualized capital cost)*** | | **1,000,794** |